Ministry for Primary Industries
Manatū Ahu Matua

A review of hoki and middle-depth summer trawl surveys of the Sub-Antarctic, November December 1991–1993 and 2000–2009

New Zealand Fisheries Assessment Report 2013/41

N.W. Bagley
S. Ballara
R.L. O'Driscoll
D. Fu
W. Lyon

ISSN 1179-5352 (online)
ISBN 978-0-478-41440-0 (online)

June 2013

New Zealand Government

Growing and Protecting New Zealand

Requests for further copies should be directed to:

Publications Logistics Officer
Ministry for Primary Industries
PO Box 2526
WELLINGTON 6140

Email: brand@mpi.govt.nz
Telephone: 0800 00 83 33
Facsimile: 04-894 0300

This publication is also available on the Ministry for Primary Industries websites at:
http://www.mpi.govt.nz/news-resources/publications.aspx
http://fs.fish.govt.nz go to Document library/Research reports

CONTENTS

Barracouta (*Thyrsites atun*) .... BAR
Banded bellowsfish (*Centriscops humerosus*) .... BBE
Barracudina (*Magnisudis prionosa*) .... BCA
Basketwork eel (*Diastobranchus capensis*) .... BEE
Black javelinfish (*Mesobius antipodum*) .... BJA
Bluenose (*Hyperoglyphe antarctica*) .... BNS
Black oreo (*Allocyttus niger*) .... BOE
Seal shark (*Dalatias licha*) .... BSH
Black slickhead (*Xenodermichthys copei*) .... BSL
Deepwater skates (*Brochiraja* sp.) .... BTH
Humpback rattail (*Coryphaenoides dossenus*) .... CBA
Cardinalfish (*Epigonus lenimen* & *E. robustus*) .... CDL
Capro dory (*Capromimus abbreviatus*) .... CDO
Banded rattail (*Coelorinchus fasciatus*) .... CFA
Viperfish (*Chauliodus sloani*) .... CHA
Giant chimaera (*Chimaera lignaria*) .... CHG
Brown chimaera (*Chimaera* sp.) .... CHP
Notable rattail (*Coelorinchus innotabilis*) .... CIN
Kaitomaru rattail (*Coelorinchus kaiyomaru*) .... CKA
Mahia rattail (*Coelorinchus matamua*) .... CMA
Abyssal rattail (*Coryphaenoides murrayi*) .... CMU
Olivers rattail (*Coelorinchus oliverianus*) .... COL
Corals .... COU
Crabs .... CRB
Serrulate rattail (*Coryphaenoides serrulatus*) .... CSE
Leaf-scale gulper shark (*Centrophorus squamosus*) .... CSQ
Four-rayed rattail (*Coryphaenoides subserrulatus*) .... CSU
Portuguese dogfish (*Centroscymnus coelolepis*) .... CYL

B. Supplement species CYO to LHO

Smooth skin dogfish (*Centroscymnus owstoni*) .... CYO
Longnosed velvet dogfish (*Centroscymnus crepidater*) .... CYP
Dawsons catshark (*Halaelurus dawsoni*) .... DCS
Dealfish (*Trachipterus trachypterus*) .... DEA
Deepwater spiny skate (*Amblyraja hyperborea*) .... DSK
Deepsea pigfish (*Congiopodus coriaceus*) .... DSP
Deepwater octopus (*Graneledone* spp.) .... DWO
Urchins .... ECN
Deepsea cardinalfish (*Epigonus telescopus*) .... EPT
Baxters lantern dogfish (*Etmopterus baxteri*) .... ETB
Lucifer dogfish (*Etmopterus lucifer*) .... ETL
Deepsea flathead (*Hoplichthys haswelli*) .... FHD
Gastropods .... GAS
Giant spider crabs (*Jacquinotia edwardsii*) .... GSC
Southern spider crab (*Leptomithrax australis*) .... SSC
Ghost shark (*Hydrolagus novaezealandiae*) .... GSH
Pale ghost shark (*Hydrolagus bemisi*) .... GSP
Giant squid (*Architeuthis* spp.) .... GSQ
Hake (*Merluccius australis*) .... HAK
Hapuku (*Polyprion oxygeneios*) .... HAP

Hairy conger (*Bassanago hirsutus*) .... HCO
Johnson's cod (*Halargyreus johnsonii*) .... HJO
Hoki (*Macruronus novaezelandiae*) .... HOK
Sea cucumbers (Holothurians) ....HTH
Javelin fish (*Lepidorhynchus denticulatus*) ....JAV
Jellyfish .... JFI
Long-nosed chimaera (*Harriotta raleighana*) .... LCH
Lookdown dory (*Cyttus traversi*) ....LDO
Giant lepidion (*Lepidion schmidti & L. inosimae*) .... LEG
Omega prawn (*Lipkius holthuisi*) ....LHO

C. Supplement species LIN to SCI

Ling (*Genypterus blacodes*) ....LIN
New Zealand King Crab (*Lithodes aotearoa*) .... LAO
Lyconus spp .... LYC
Mako shark (*Isurus oxyrinchus*) .... MAK
Finless flounder (*Neoachiropsetta milfordi*) .... MAN
Ridge scaled rattail (*Macrourus carinatus*) .... MCA
Moonfish (*Lampris guttatus*) ....MOO
Brodie's king crab (*Neolithodes brodiei*) ....NEB
Umbrella octopus (*Opisthoteuthis* spp.) .... OPI
Octopoteuthidae .... OSQ
Opah (*Lampris immaculatus*) ....PAH
Prickly dogfish (*Oxynotus bruniensis*) .... PDG
Porbeagle shark (*Lamna nasus*) ....POS
Prawns ....PRA
Longnosed deepsea skate (*Bathyraja shuntovi*) .... PSK
Blobfish (*Psychrolutes microporos*) .... PSY
Ragfish (*Pseudoicichthys australis*) .... RAG
Ray's bream (*Xenobrama microlepis, Brama brama, B. australis*) ....RBM
Widenosed chimaera (*Rhinochimaera pacifica*) .... RCH
Red cod (*Pseudophycis bachus*) .... RCO
Ribaldo (*Mora moro*) .... RIB
Rough skate (*Zearaja nasuta*) ....RSK
Rudderfish (*Centrolophus niger*) .... RUD
Salps .... SAL
Bigscaled brown slickhead (*Alepocephalus australis*) .... SBI
Spineback (*Notacanthus sexspinis*) .... SBK
Southern blue whiting (*Micromesistius australis*) ....SBW
Smallscaled cod (*Paranotothenia microlepidota*) ....SCD
School shark (*Galeorhinus galeus*) ....SCH
Scampi (*Metanephrops challengeri*) .... SCI

D. Supplement species SCO to WWA

Swollenhead conger (*Bassanago bulbiceps*) .... SCO
Silver dory (*Cyttus novaezealandiae*) .... SDO
Starfish ....SFI
Gemfish (*Rexea solandri*) .... SKI
Small-headed cod (*Lepidion microcephalus*) .... SMC
Shovelnose spiny dogfish (*Deania calcea*) ....SND

EXECUTIVE SUMMARY

Bagley, N.W.; Ballara, S.L.; O'Driscoll, R.L.; Fu, D.; Lyon, W. (2013). A review of hoki and middle depth summer trawl surveys of the Sub-Antarctic, November December 1991–1993 and 2000–2009.

***New Zealand Fisheries Assessment Report 2013/41.* 63 p (plus supplements).**

Summer trawl surveys for hoki and other middle depth species have been carried out in Sub-Antarctic and Southland waters using *Tangaroa* from 1991–1993 and 2000–2009 and these are the focus of this report. Thirteen surveys covering depths between 300 to 1000 m were carried out in November-December from 1991–1993 and 2000–2009. Each of these surveys covered a core area from 300 to 800 m on the Southern Plateau and Puyseger, plus one deep stratum in 800–1000 m at Puysegur.

This report reviews all 13 surveys in the time series. The aim was to provide fisheries-independent data for a much broader range of species than is currently available in annual survey reports, informing us about which species are adequately monitored by the existing trawl series and identifying gaps where additional data need to be collected. This is particularly important in light of broader scrutiny of the effects of fishing on associated species.

This work differs from previous reviews, by being species-based rather than community-based. Results in this report are summarised by species, assembling together all available survey-based information for a particular species in a standard format. A second, autumn time series of trawl surveys in Sub-Antarctic waters conducted in March–June 1992, 1993, 1996 and 1998 is not covered in this report.

A total of 426 species or species groups have been recorded in the 13 surveys. The number of species recorded has increased over time, mainly due to improvements in identification of benthic invertebrates. Where there has been a change in the level of identification over time, species were grouped into broader taxonomic classes. Biomass trends and spatial and depth distributions were estimated for 134 species or groups. Biomass was poorly estimated (arbitrarily defined as having mean c.v. greater than 40%) for 91 of the 134 species or species groups. For the remaining 43 groups where biomass was relatively well-estimated, biomass decreased significantly since the start of the time series for five species: hake, hoki, omega prawns, pale toadfish and warty squid. The serrulate rattail also decreased in the middle part of the time series but has subsequently increased, while lookdown dory and lanternfish have increased then decreased. The remaining 28 groups showed no clear trend.

Length data was collected from 389 394 individuals of 108 species. Of these, 35 species had sufficient information to estimate scaled length frequency distributions by year. From the 35 groups where length data are presented 26 have mean biomass c.v.s of below 40%. Sixteen showed no clear trend in mean length over the period for which length measurements were available. Mean length decreased for 7 species (hoki, hake, ling, southern blue whiting, ribaldo, Lucifer dogfish and southern spiny dogfish) while only leafscale gulper shark increased in mean length. Twenty species exhibited multiple modes in length frequency data which may track changes in year-class strength. Other biological information, such as maturity stage was summarised for species for which these data have been collected. Relatively few species have been recorded in spawning condition (ripe or running ripe) during the survey.

Due to electronic file size limitations the species summaries are presented in four separate documents. These are broken up by the three letter species code: supplement 9A, AGR to CYL; supplement 9B, CYO to LHO; supplement 9C, LIN to SCI and supplement 9D, SCO to WWA.

1. INTRODUCTION

The core survey area encompasses the area south of New Zealand covering Southland and Sub-Antarctic waters. These include Puysegur, east of Southland, east and west of Stewart Island, around the Auckland Islands, and the Southern Plateau. The main focus of the early summer trawl surveys (1991–93) was to estimate the abundance of hoki and covered a set of core strata covering the Sub-Antarctic and Southland areas between 300 and 800 m. One additional stratum at Puysegur in 800 to 1000 m was included with the core strata to cover known hake distribution. The Bounty Platform was surveyed in 1992 and 1993 but discontinued from 2000 onwards. Additional strata in 800–1000 m were included from 2000; east of Stewart Island; north of Pukaki Rise; and south of Campbell Island.

The Southern Plateau is a broad bathymetric feature covering a large area to the south and southeast of New Zealand (Figure 1). Cooler water flowing from the Antarctic current dominates the eastern part of the Plateau. A Sub-Tropical water mass flows in from the east/northeast part of the survey area and a convergence zone is formed where the two current systems meet. Current flow is predominantly west to east (Heath 1975). Species distributions and species preferences are often influenced by the two distinct water masses.

Two time series of trawl surveys have been carried out from *Tangaroa* in the Southland and Sub-Antarctic region: a summer series in November–December 1991–1993 and 2000–2009, and an autumn series in March–June 1992, 1993, 1996 and 1998 (reviewed by O'Driscoll & Bagley (2001)).

The surveys in 1996 and 1998 were developed primarily for hake and ling. Autumn was chosen for these species as the biomass estimates were generally higher and more precise at this time of year. Autumn surveys also allowed the proportion of hoki maturing to spawn to be estimated (Livingston et al. 1997, Livingston & Bull 2000). However, interpretation of trends in the autumn trawl survey series was complicated by the possibility that different proportions of the hoki adult biomass may have already left the survey area to spawn. The timing of the trawl survey was moved back to November-December in 2000 to obtain an estimate of total adult hoki biomass at a time when abundance should be at a maximum in the Southland and the Sub-Antarctic areas.

All surveys in the series were carried out from RV *Tangaroa* using a standard set of protocols and procedures as given in Hurst et al. (1992). The surveys followed a random stratified design after Francis (1984), with stratification by depth, longitude, and latitude across the Sub-Antarctic to ensure full coverage of the area (Figure 1).

Previous surveys in this time series have been documented in individual survey reports (see Table 1 for references). As well as the publication of survey results for each year, trends in biomass and changes in catch and age distribution were previously reviewed for both the summer and autumn surveys by O'Driscoll & Bagley (2001). Tuck et al. (2009) analysed the Sub-Antarctic trawl series data from 1991–2006 and derived ecosystem indicators based on measures of diversity, fish size, and trophic level in an attempt to identify the effects of fishing on fish communities.

Hoki are the target of New Zealand's largest fishery, with annual catches of 90 000 to 250 000 t since 1986 (Ballara et al. 2010). The Sub-Antarctic is one of the major feeding areas for New Zealand adult hoki (Livingston et al. 2002a). The main aim of the summer Sub-Antarctic surveys has been to provide relative biomass estimates of adult hoki. Although managed as a single stock, hoki is assessed as two stocks, western and eastern. The current hypothesis is that juveniles from both stocks mix on the Chatham Rise and recruit to their respective stocks as they approach sexual maturity. The Sub-Antarctic is the principal residence area for adult hoki that spawn off the South Island's West Coast in winter (western stock). Juvenile hoki are found within the survey area in north-western waters around Stewart Island and Puysegur. The hoki fishery is now recruitment driven and therefore subject to large fluctuations in stock size. Although the TACC for hoki has been greatly reduced since 2000–2001, hoki is still New Zealand's largest fishery.

Other middle depth species are also monitored by this survey time series. These include important commercial species such as hake and ling, as well as a wide range of non-commercial fish and invertebrate species. For most of these species, the trawl survey is the only fisheries-independent estimate of abundance from Southland and the Sub-Antarctic (Fisheries Management Areas 5 and 6), and the survey time-series fulfils an important "ecosystem monitoring" role (e.g., Tuck et al. 2009), as well as providing inputs into single-species stock assessment.

The key aims of this review were to:

1. Document trends in biomass for all species caught where the catch weight from all surveys exceeded 10 kgs;
2. Summarise spatial and depth distributions for all species caught;
3. Document trends in size and sex composition for the subset of species which are routinely measured.

This report provides fisheries-independent data for a much broader range of species than was previously available. Annual survey reports routinely only present biomass trends for 12 key species. This review will help inform us about which species are adequately monitored by the existing trawl series and allow us to identify gaps where additional data need to be collected. This is particularly important in light of broader scrutiny of the effects of fishing on associated species, for example as part of the Principle 2 criteria for Marine Stewardship Council certification.

This report does not summarise environmental, acoustic data or hoki condition indices collected during the Sub-Antarctic trawl survey series.

1.1 Project objectives

This work was carried out under contract to the Ministry of Fisheries (MDT2010/01 Objective 6). The specific objective for the project was:

To review the Sub Antarctic summer trawl time-series 1991–1993 and 2000–2009.

2. METHODS

2.1 Survey area and design

All summer surveys covered a core set of strata in 300–800 m depths on the Southern Plateau and included an 800–1000 m stratum at Puysegur (Figure 1). From 2000 onwards additional deeper strata were included in the survey area to the east of the Southland Coast, and north and south of the Southern Plateau. The area east of the Southern Plateau did not extend out past 800 m due the rough nature of the seafloor. Stratum 26 in 800–1000 m to the south of Campbell Island was not surveyed in 2003, 2004 or 2006 due to lost vessel time for bad weather, search and rescue, and medical emergency. In 1992 and 1993 the survey area also included one stratum at the Bounty Platform.

Stratification of the core survey area is based on depth intervals (i.e., 300–600 m, 600–800 m, and 800–1000 m), and further subdivided by latitude and longitude. The stratification has undergone minor changes over the time series, particularly the division of strata to the east and south of the Stewart/Snares shelf into two. Strata 3 and 5 were subdivided (into strata 3A and 3B and 5A and 5B, see Figure 1) after 2000 to increase coverage in the region where hake and ling aggregations were thought to occur (Bull et al. 2000). Our analysis software has taken account of this by re-assigning stations to present strata numbers and by using combined stratum areas in years when strata were not separated (Appendices 1 and 2). Where stratum areas have changed over time, indices were calculated using present stratum areas. The number of stations and subtotals for the core strata and for all strata for all surveys in the time series is given in Table 2.

Surveys followed a two-phase random design (after Francis 1984). Since 2000 the surveys have been optimised to obtain target coefficient of variations (c.v.s) of 15% for hoki, 15% for ling and 20% for hake. Improved optimisation and rationalisation of survey timing allowed for a decrease in station numbers since the summer series was reinstated in 2000 (Table 2).

2.2 Vessel and gear specifications

Tangaroa is a purpose-built, research stern trawler of 70 m overall length, a beam of 14 m, 3000 kW (4000 hp) of power, and a gross tonnage of 2282 t.

The bottom trawl used in the Sub-Antarctic time series is an eight-seam hoki bottom trawl with 100 m sweeps, 50 m bridles, 12 m backstrops, 58.8 m groundrope, 45 m headline, and 60 mm codend mesh (see Hurst et al. (1992) for net plan and rigging details). The trawl doors were Super V type with an area of 6.1 m^2.

2.3 Trawling procedure

Trawling followed the standardised procedures described by Hurst et al. (1992). Station positions were selected randomly before the voyage using the Random Stations Generation Program developed at NIWA. A minimum distance between stations of 3 n. miles was used. If a station was found to be on foul ground, a search was made for suitable ground within 3 n. miles of the station position. If no suitable ground could be found, the station was abandoned and another random position was substituted. Occasionally a different strategy had to be employed due to the long steaming distances between stations, particularly in the large strata to the east of the survey area. If the last random station of the day could not be reached before nightfall the vessel steamed towards it and, provided at least 50% of the distance to the next station was covered and there was sufficient time to ensure that the station was completed in daylight, the tow was attempted.

At each station the trawl was towed for 3 n. miles at a speed over the ground of 3.5 knots. If foul ground was encountered, or the tow hauled early due to reducing daylight, the tow was accepted as valid (suitable for biomass estimation) only if at least 2 n. miles had been covered. Biomass tows were carried out during daylight hours (as defined by Hurst et al. (1992).

Towing speed and gear configuration were maintained as constant as possible during the survey, following the guidelines given by Hurst et al. (1992). Tow positions were recorded by GPS and depths from the vessel's echosounder. Measurements of doorspread (from a Scanmar 400 system) and headline height (from a Kajo Denki (1991–1993) and Furuno CN22 net monitor (2000–2009)) were recorded every five minutes during each tow and average values calculated.

2.4 Catch and biological sampling

At each station all items in the catch were sorted into species and weighed on Seaway motion-compensating electronic scales accurate to about 0.3 kg. Where possible, fish, squid, and crustaceans were identified to species and other benthic fauna to species or family. The level of taxonomic identification at sea has improved over time with development of identification guides for fish and benthic invertebrates (Tracey et al. 2007).

The level of biological sampling has varied between years, and has increased over the time series (see Section 3.2). In general, an approximately random sample of up to 200 individuals of each commercial, and some common non-commercial species from every successful tow was measured and sex determined. More detailed biological data were also collected on a subset of species and included fish weight, sex, gonad stage, and gonad weight. Otoliths were taken from hake, hoki, and ling for age determination. Additional data (e.g., stomach samples, data on hoki liver condition, genetic samples) were collected in some surveys but are not described in this report.

2.5 Analysis methods

Analyses were carried out using the NIWA custom software SurvCalc. SurvCalc is a C++ computer program developed in 2008 which analyses data from stratified random surveys (Francis 2009). Its primary purpose is to calculate estimates of biomass and/or length frequencies, and associated coefficients of variation (c.v.s), from survey data. SurvCalc supersedes, and uses some code from, the Trawlsurvey program (Vignaux 1994). The main input file for SurvCalc has been designed so that it fully documents all the choices the user makes in calculating biomass etc. (e.g., the choice of stations to include, and how distance towed is calculated if there is no recorded value). The SurvCalc input files are included as Appendices 1, 2 and 3.

SurvCalc extracts data from the trawl database for all stations on these surveys which fulfil the criteria for 'biomass' tows (i.e., daylight tows with the standard bottom trawl where gear performance was satisfactory). Data were extracted from the Empress database "trawl" and analyses run on 7 April 2011.

2.5.1 Estimation of abundance

An extract of data from all summer surveys from 1991–1993 and 2000–2009 indicated that there are 426 biological groups recorded on the catch database from these surveys (Table 3). This included a large number of invertebrates with very low catch weights or frequency of occurrence. Abundance indices were calculated for individual species considered to have been accurately identified from all surveys and combinations of species or groups where identification varied over the time series. Biomass was calculated for all species or groups where there was more than 10 kg of catch (combined over all surveys).

A total of 297 groups fulfilled these criteria (Table 3). For example, most crabs were combined into one group as these would have originally been coded as a generic code for crab (CRB) on early surveys, however some of the larger crabs were treated as individual species as these are considered well identified over the time series. Many other benthic invertebrates were similarly grouped (Table 4). In the same way many mesopelagic fish species were grouped, because their identification at sea is difficult and depended on the (variable) taxonomic skills of staff available on the vessel. We also grouped species where taxonomy has evolved over time, for example most Ray's bream (*Brama* spp.) are now identified as southern Ray's bream (*Brama australis*), and bronze bream (*Xenobrama microlepis*) with these two species not recognised on earlier surveys. On the very early surveys, particularly 1991, the identification and recording of benthic fauna was poor, so some estimates may be low for some members of this group. Some codes were known to be incorrect and changes made, for example DEQ (*Deania quadrispinosum*) was only recorded on one survey and combined with SND (*Deania calcea*). Where species codes have been grouped, details are provided as footnotes in the species summaries, and are summarised in Table 4.

Doorspread biomass was estimated by the swept area method of Francis (1981, 1989) using the formulae in Vignaux (1994) as implemented in SurvCalc (Francis 2009). Where stratum areas have changed over time, indices were calculated using present stratum areas. This means that abundance estimates may differ slightly from those previously published in individual survey reports (see Section 3.3). The catchability coefficient (an estimate of the proportion of fish in the path of the net which are caught) is the product of vulnerability, vertical availability, and areal availability. These factors were set at 1 for the analysis, the assumptions being that fish were randomly distributed over the bottom, that no fish were present above the height of the headline, and that all fish within the path of the trawl doors were caught.

The SurvCalc input file used to estimate abundance is given in Appendix 1 for all strata, and Appendix 2 for core strata.

2.5.2 Distribution and catch rate plots

The spatial distributions of the same 134 species or groups that were selected for abundance estimation were summarised by depth, latitude, and longitude. Catch data were matched up to station data using trip codes and station numbers and presence/absence plots produced.

Depth was divided into 20 m bins and the total number of tows over the time series was summed for each bin. For each species or group, the total number of tows for each depth bin in which that species or group was present was also summed. This was then divided by the total number of tows in that depth bin to give the proportion of tows in each depth bin for which the species was present. The same process was done for latitude using bins of 0.05 degrees, and for longitude using bins of 0.5 degrees.

Catch rates were plotted for a smaller subset of 35 species which were most adequately and consistently sampled. This subset is the same group of species for which length frequencies were estimated (see Section 2.5.3). The previous review by O'Driscoll & Bagley (2001) plotted catch rates for 12 species.

2.5.3 Estimation of length frequencies

A total of 389 394 individuals from 108 species have been measured in these surveys (see Table 3). Minimum, maximum, and mean sizes were tabulated for species or species groups where applicable and are given in the species summaries. A smaller subset of 35 species were selected as having sufficient information to estimate scaled length frequency distributions (arbitrarily defined as more than 500 length measurements with consistent sampling across multiple years).

Length-weight parameters were estimated for these 35 species from the subset of fish individually weighed from all surveys in the series. Data were groomed and outliers where residual values exceeded +0.3 or -0.3 were removed for the larger species while smaller fish e.g. some rattail species used a +0.5 or -0.5 cut off. Scaled length frequencies were then calculated with SurvCalc and scaled length distributions plotted by year and sex. The previous review by O'Driscoll & Bagley (2001) plotted length frequencies for 11 species.

The SurvCalc input file used to estimate length frequencies is given in Appendix 3.

2.5.4 Estimation of numbers at age

Hoki, hake, and ling otoliths were prepared and aged using validated ageing methods (hoki, Horn & Sullivan (1996) as modified by Cordue et al. (2000); hake, Horn (1997); ling, Horn (1993)). Numbers at age were calculated from observed length frequencies and age-length keys using customised NIWA catch-at-age software (Bull & Dunn 2002). For hoki, this software also applied the "consistency scoring" method of Francis (2001), which uses otolith ring radii measurements to improve the consistency of age estimation.

2.6 Gonad stage information

The reproductive condition of a subset of species was estimated during the surveys and was tabulated where appropriate. Care needs to be taken when interpreting the gonad stage information as there are discrete areas during the summer series where particular species (e.g. ling) are known to spawn.

Fish were staged using a range of gonad staging methods, which are defined as follows:

Middle depths gonad stages: 1, immature; 2, resting; 3, ripening; 4, ripe; 5, running ripe; 6, partially spent; 7, spent. (after Hurst et al. 1992).

Deepwater gonad stages were recorded for some orange roughy, smooth oreo, spiky oreo and black oreo (after McMillan 1996). These stages were converted to middle depths stages and combined when the two staging methods had been used for a single species.

Cartilaginous fish gonad stages: male: 1, immature; 2, maturing; 3, mature; female: 1, immature; 2, maturing; 3, mature; 4, Gravid I; 5, Gravid II; 6, post-partum.

2.7 Species summaries

Results are presented by species for the 112 species and 22 groups defined in Section 2.5.1, assembling all available survey-based information for a particular species. Due to electronic file size limitations of a maximum of 25 MB the species summaries are presented in four separate supplements sorted alphabetically by the 3 letter species code (supplements 9A, 9B, 9C and 9D. These summaries follow the format of O'Driscoll et al. (2011b) and include the following:

a) Title giving common name, scientific name in parentheses, and species code (see Table 3).

b) A specimen photograph.

c) A table summarising the number of surveys caught from valid summer time series biomass stations, the total catch weight, number measured, length range (if any were measured), number individually weighed, and length-weight parameters (for the subset of 35 species defined in Section 2.5.3 only).

d) A paragraph of generic text. Words in **bold** have defined meanings:

The core survey area and depth range **is / is not** appropriate for this species. It is **pelagic** / found **shallower than 300 m / deeper than 800 m**.

Area and depth defined as appropriate if species distribution is usually between 300–800 m and not appropriate if distribution is typically deeper or shallower or is known to be pelagic.

There were **too few fish caught to determine whether the core survey area is appropriate for this species**.

Where sample sizes were too small to describe the distribution, it is noted that there were too few fish caught to determine whether the core survey area is appropriate.

Biomass of this species is **very well / well / moderately well / poorly** estimated by the core survey.

- Very well = mean c.v. less than 20%
- Well = mean c.v. 20–30%
- Moderately well = mean c.v. 30–40%
- Poorly = mean c.v. more than 40%

Biomass has **increased / decreased / increased then decreased / decreased then increased / shows no clear trend** since the start of the time series.

Definitions were based on a randomization test of the ranks of the biomass indices. The series of 13 surveys was divided into three periods (1991–1993, 2000–2004, 2005–2009). The mean rank for each of the three periods was compared to a test statistic calculated from the 5th and 95th percentile of a random arrangement of ranks from 1000 bootstraps of the data.

- If the mean rank of the abundance indices in 1991–1993 was significantly ($p < 0.05$) lower and/or mean rank of abundance indices in 2005–2009 was significantly higher than expected from a random arrangement of ranks then biomass had increased.
- If the mean rank of the abundance indices in 1991–1993 was significantly higher and/or mean rank of abundance indices in 2005–2009 was significantly lower than expected then biomass had decreased.
- If the mean rank of the abundance indices in 2000–2004 was significantly lower than expected then biomass had decreased then increased.
- If the mean rank of the abundance indices in 2000–2004 was significantly higher than expected then biomass had increased then decreased.
- If the mean rank in each of the three periods was not significantly different from that expected from a random arrangement of ranks then biomass shows no clear trend.

Catch rates are highest in the **north / northwest / south / east / northeast / west.**

The spatial distribution for species based on frequency of occurrence and catch rate plots where available is described. More than one area may be selected.

Length frequencies **are usually unimodal / bimodal / have multiple modes which may contain information about year-class strength**.

Mean length has **increased / decreased / increased then decreased / decreased then increased / shows no clear trend** since the start of the time series.

For the 35 species where length frequency data are presented, a brief description is provided. Definitions for trends in mean length are the same as those used for biomass indices and were based on a randomization test of the ranks of the mean lengths.

Gonad stage data indicate that most fish are **immature / resting / maturing / spawning / spent / there is no gonad stage information**.

e) Distribution plots for the survey area showing the presence or absence from all valid biomass tows in the time series.

f) Distribution plots comparing the percent occurrence by depth, latitude, and longitude for the species with overall survey effort (see Section 2.5.2 for details).

g) Table of relative biomass estimates by survey for all species broken down by:
- the core survey area (strata 1 to 25),
- deepwater strata (stratum 27 and 28) completed every year since 2000,
- deepwater stratum south of Campbell Island (stratum 26),
- the Bounty Platform (stratum 17).
- Totals from all strata are also included for each survey.

f) Plot of relative biomass estimates. Confidence intervals are based on estimated 5th and 95th percentiles for the core survey area and for all strata.

g) Catch rate plots by survey. Crosses are zero catch. Filled circle area is proportional to catch rate, with the circle size scaled to the maximum catch in the time series (Table 5). For species where a large single catch was taken the data was scaled to ensure that circle sizes for the smallest catches remained visible as follows:

- Maximum catch rate between 1000 and 12 000 $kg.km^{-2}$: the scaled minimum catch rate is the maximum catch rate/100.

- Maximum catch rates between 500 and 1000 kg.km^{-2}: the scaled minimum catch rate is the maximum catch rate/200.
- Maximum catch rates below 500 kg.km^{-2}: no scaling.

h) Length summaries by survey including length ranges and mean length.

i) Length frequency plots for 35 selected species only (see Section 2.5.3).

j) Plots of numbers at age for hoki, hake, and ling only (see Section 2.5.4).

k) Gonad stage summaries. Numbers show the proportion (by sex) in each gonad stage and the numbers of males and females staged. Staging method is MD for middle depths or SS for elasmobranchs (see Section 2.6 for definition of stages).

3. RESULTS

3.1 Survey comparability

All surveys in the time-series have covered the same core survey area and used the same vessel, gear, and standardised protocols. The total number of stations has ranged between 81 (in 2004) and 160 (in 1992) (see Table 2). The number of days on the survey grounds has reduced from about 36 days in the early 1990 surveys to 26 from 2000. Trawl gear parameters have remained relatively consistent within the time series (Table 6).

3.2 Catch and biological sampling

As noted in Section 2.5.1, there were 426 biological groups recorded on the catch database for this series (Table 3). Data in Table 3 are from all stations where species were identified and may include some trawls outside the core survey area. For example, additional deeper strata were added for the 2000–2009 surveys (800–1000 m) and the Bounty Platform in 1992 and 1993.

The number of individual species or groups recorded during the survey has more than doubled over the time-series from 103 in 1991 to 203 in 2009 (Figure 2). This increase is largely due to an increase in the level of species identification of invertebrates since the period 2000 to 2003, instigated by the provision of more detailed identification guides (e.g., Tracey et al. 2007). This is particularly apparent for groups like Cnidaria, crustaceans, echinoderms, molluscs, and sponges (Figure 2). Overall, there has been a six-fold increase in the number of invertebrate groups identified over the time-series (from 15 in 1991 to 88 in 2003), while over the same period the number of fish groups (teleosts and elasmobranches) identified in each survey has only varied by about 30%.

There were 66 teleost and 23 elasmobranch species or groups identified in 1991, increasing to 95 and 24 respectively in 2000. The number of teleosts has increased from the early surveys with the capture of deepwater species from the deeper strata added from 2000, and better at-sea identification. The number of fish species caught within the core area has remained between 88 and 127 groups over the time series. For the early surveys (1991–1993) between 88 and 90 fish groups were identified increasing to 113 to 127 from 2000–2009. The largest increase is with teleosts, with 66 species or groups recorded in 1991, 95 in 2000 and 88 in 2009. The number of elasmobranchs has remained much the same throughout the time series. Occasionally fish taxonomy has changed over time (for example most Ray’s bream are now identified as southern Ray’s bream), and these “species” were also grouped (Table 4).

The level of invertebrate classification has increased over time, and this must be considered when carrying out any species-based analysis of biodiversity (e.g., Tuck et al. 2009). In this report, most invertebrates have been grouped at the higher taxonomic level at which we believe identification has been relatively consistent. However, catches of some benthic invertebrates were not recorded in some early surveys.

A total of 389 394 individuals from 108 groups were measured and 130 537 individuals from 98 groups were individually weighed from all surveys (see Table 3). The level of biological sampling has varied between years, but has increased over the time series (Figure 3). In 1991, 6 species (hoki, hake, ling, orange roughy, smooth oreo and southern blue whiting) were individually weighed, increasing to 26 species in 2000 and to 70 species in 2009. The number of fish measured has varied between 22 413 and 41 968 individuals per survey. Numbers measured were around 28 000 fish in the early 1990's due to the higher number of stations completed on the early surveys. Biological data were collected from 2 963 individuals in 1991, 7 599 in 2000 and 15 787 in 2009.

3.3 Trends in relative abundance

Biomass was estimated for 134 species or groups (Table 7, Section 9). Biomass estimates for surveys from 1991–1993 differed slightly (usually less than 1%) from estimates published in the original survey reports (see Table 1) and the earlier review (O'Driscoll & Bagley 2001). This is because of small differences in stratification. In this review we re-assigned stations to current strata numbers and areas (see Section 2.1), which was different to the early stratification.

Biomass was poorly estimated (arbitrarily defined as where the mean c.v. is greater than 40%) for 91 of the 134 groups (Table 7). Of the remaining 43 groups where biomass was relatively well estimated, the core survey area was considered inappropriate for 22 groups: 2 had distributions shallower than 300 m, 18 had distributions deeper than 800 m, and 1 was pelagic. The core survey may still provide valid relative indices of abundance for groups where the distribution extends beyond the survey boundaries as long as the proportion inside the survey area is constant.

The inclusion of deep strata from 2000 enables comparisons to be made for two of the three strata, strata 27 and 28. Estimates for the deep strata included in the survey from 2000 are given in the species summaries but not reported on here as they are not part of the core survey area. Estimates from the Bounty Platform from 1992 and 1993 are also reported in the species summaries.

The rank test used to determine whether there were significant changes in abundance over the time series was unsophisticated, but had the advantage over regression-based metrics (e.g., Bull et al. 2001, Livingston et al. 2002b) that simple non-linear patterns could also be detected. For the 43 groups where mean c.v.s were less than 40%, biomass decreased significantly since the start of the time series for five species: hoki, hake, warty squid, omega prawn and pale toadfish (Table 7). One species decreased in the middle part of the time series but subsequently increased. Seven groups have increased significantly, two increased and then decreased, and 28 showed no clear trend. Note that caution should be applied to interpreting trends in biomass for groups where there is a suggestion that these were inconsistently recorded during early surveys. This includes most benthic invertebrate groupings.

This review differs from the previous review of O'Driscoll & Bagley (2001) which focused on 12 key species.

3.4 Length frequency distributions

Length frequencies were plotted for 35 species with more than 500 length measurements (Section 9). The key commercial species were measured in all years but other minor species were consistently measured only from about 2001. However, all of the abundant species and most of the species for which biomass is relatively well-estimated (see Section 3.3) have been measured since 2003. This will allow us to build up a time-series of length measurements from a broader range of species with which to monitor size-based ecosystem indicators into the future (e.g. Tuck et al. 2009). Because of the lack of consistent length data, the size-based indices of Tuck et al. (2009) were only estimated for a core group of 10 species (dark ghost shark, pale ghost shark, hake, hoki, lookdown dory, ling, spiny dogfish, southern blue whiting, giant stargazer, and ribaldo).

Of the 37 species considered in this report, 24 showed no clear trend in mean length over the period for which length measurements were available, mean length decreased for 8 species, increased for 3 species, decreased then increased for 1 species, and increased then decreased for 1 species (see Table 7).

Twenty five species showed multiple modes in length frequency data which may be used to track changes in year-class strength. This has been demonstrated for hoki, hake, and ling, but other well-estimated species such as southern blue whiting, lookdown dory, and dark and pale ghost sharks also appear to have length modes which track between years (see Section 9).

3.5 Catch rates

Catch rates and distribution plots provided useful summaries of species distributions. Of the 134 species or groups considered, 127 had sufficient information to draw conclusions about depth distribution (see Table 7). Of these 41 appeared to occur mainly within the core survey depth limits of 300–800 m, the distribution of 19 species or groups extended shallower than 300 m, 56 extended deeper than 800 m, and 11 were pelagic. The relatively high number of groups whose depth distributions extend deeper than 800 m may have been a result of the additional deep strata added from 2000.

The spatial distribution of individual species was variable with larger catch rates generally associated with the western part of the survey area. The influence of sub-tropical water in the west, particularly in the Puysegur area accounts for the higher catch rates of some species. Within the two distinct water masses species may aggregate by size e.g. small hoki under 65 cm are almost exclusively taken in the western part of the survey area while large hoki more than 65 cm are taken throughout the survey area with higher numbers to the east.

3.6 Gonad stages

With the exception of hoki, hake, and ling, collection of data on gonad stages has been intermittent over the time series. Table 8 summarises maturity stages for 48 species. Actual proportions are given in Section 9. Eight species have been recorded in spawning condition (ripe or running ripe) during the survey and are barracouta, banded stargazer, hake, lookdown dory, ling, red-cod, smallscaled brown slickhead and tarakihi (Table 8). There are distinct areas where spawning occurs i.e. ling and hake at Puysegur and around the Stewart/Snares shelf.

There has been increased effort collecting gonad stage data from a wider range of species, in particular elasmobranchs, reflecting an initiative in the past two surveys to collect maturity information on this group. This has included the development of an appropriate staging classification for cartilaginous fish (see Section 2.6).

4. CONCLUSIONS

- With 13 surveys, 10 being consecutive surveys, the summer Sub-Antarctic time series is the second longest time-series in New Zealand fisheries.

- The 7 year gap between the summer surveys ending in 1993 and recommencing in 2000 requires care when making comparisons between the early and later surveys. However from 2000 the surveys have been annual providing a good dataset to monitor trends.

- The 2003 survey showed a decline for a number of species. This survey experienced poor weather throughout and was compromised slightly with lost time for a search and rescue.

- The core survey area has remained the same, although there have been some changes in stratification and estimated stratum areas.

- Gear performance metrics have been relatively consistent.

- The number of species recorded has more than doubled since the start of the time-series, mainly due to improvements in identification of benthic invertebrates. This needs to be taken into account when estimating species-based indices of diversity.

- Biomass was estimated for 134 species or groups which exceeded selection criteria of more than 10 kg of catch (combined over all surveys). Of these, 41 species or groups were relatively well estimated by the survey (mean c.v. less than 40%).

- Five of the 43 well-estimated species or groups declined significantly since the start of the time series, 1 species decreased in the middle part of the time series but subsequently increased, 7 groups increased significantly, 2 increased and then decreased, and 28 showed no clear trend.

- Over three hundred and eighty nine thousand individuals from 108 species or species groups have been measured on Sub-Antarctic trawl surveys. Of these, 37 species had sufficient information to estimate scaled length frequency distributions by year. Most showed no clear trend in mean length over the period for which length measurements were available. Twenty five species exhibited multiple modes in length frequency data which may track changes in year-class strength.

- With the exception of hoki, hake, and ling, collection of data on gonad stages has been intermittent, but has increased in recent years, particularly for elasmobranchs. Relatively few species have been recorded in spawning condition (ripe or running ripe) during the survey. However in parts of the survey area some species e.g. hake and ling do spawn during this time period.

- Generic input file have been written to carry out analyses in SurvCalc. This will allow us to easily and efficiently update these analyses in the future. Outputs from this project can also be used to update ecosystem indicators (Tuck et al. 2009).

5. ACKNOWLEDGEMENTS

We thank the scientific staff and the master, officers, and crew of *Tangaroa* involved in each of the 13 voyages in the Sub-Antarctic time series. Special thanks to Darren Stevens for reviewing this report. Images in Section 9 are from Tracey et al. (2007) and McMillan et al. (2011) and were taken by NIWA staff, with the exceptions of images of MAK which were courtesy of the Ministry of Fisheries Observer Programme. This work was carried out by NIWA under contract to the Ministry of Fisheries (Project MDT201001 Objective 6).

REFERENCES:

Bagley, N.W.; O'Driscoll, R.L. (2008). Trawl survey of hoki, hake, and ling in the Southland and Sub-Antarctic areas, November–December 2007 (TAN0714). *New Zealand Fisheries Assessment Report 2009/9.* 63 p.

Bagley, N.W.; O'Driscoll, R.L. (2012). Trawl survey of middle depth species in the Southland and Sub-Antarctic areas, November–December 2009 (TAN0911). *New Zealand Fisheries Assessment Report 2012/05*. 70 p.

Bagley, N.W.; O'Driscoll, R.L.; Francis, R.I.C.C.; Ballara, S.L. (2009). Trawl survey of middle depth species in the Southland and Sub-Antarctic areas, November–December 2007 (TAN0714). *New Zealand Fisheries Assessment Report 2009/9*. 63 p.

Ballara, S.L.; O'Driscoll, R.L.; Fu, D. (2010). Catches, size, and age structure of the 2007–08 hoki fishery, and a summary of input data used for the 2009 stock assessment. *New Zealand Fisheries Assessment Report 2010/18*. 98 p.

Bull, B.; Bagley, N.W.; Hurst, R.J. (2000). Proposed survey design for the Southern Plateau trawl survey of hoki, hake and ling in November-December 2000. Final Research Report to the Ministry of Fisheries for Research Project MDT1999/01 Objective 1. 31 p. (Unpublished report held by Ministry for Primary Industries, Wellington.)

Bull, B.; Livingston, M.E.; Hurst, R.; Bagley, N. (2001). Upper-slope fish communities on the Chatham Rise, New Zealand, 1992-1999. *New Zealand Journal of Marine and Freshwater Research 35*: 795–815.

Bull, B.; Dunn, A. (2002). Catch-at-age user manual v1.06.2002/09/12. NIWA Internal Report 114. 23 p. (Unpublished report held in NIWA library, Wellington.)

Chatterton, T.D.; Hanchet, S.M. (1994). Trawl survey of hoki and associated species in the Southland and Sub-Antarctic areas, November-December 1991 (TAN9105). *New Zealand Fisheries Data Report 41*. 55 p.

Cordue, P.L.; Ballara, S.L.; Horn, P.L. (2000). Hoki ageing: recommendation of which data to routinely record for hoki otoliths. Final Research Report to the Ministry of Fisheries for Research Project MOF1999/01 (Hoki ageing). 24 p. (Unpublished report held by Ministry for Primary Industries, Wellington.)

Francis, R.I.C.C. (1981). Stratified random trawl surveys of deep-water demersal fish stocks around New Zealand. *Fisheries Research Division Occasional Publication 32*. 28 p.

Francis, R.I.C.C. (1984). An adaptive management strategy for stratified random trawl surveys. *New Zealand Journal of Marine and Freshwater Research 18*: 59–71.

Francis, R.I.C.C. (1989). A standard approach to biomass estimation from bottom trawl surveys. New Zealand Fisheries Assessment Research Document 89/3. 3 p. (Unpublished report held in NIWA library, Wellington.)

Francis, R.I.C.C. (2001). Improving the consistency of hoki age estimation. *New Zealand Fisheries Assessment Report 2001/12*. 18 p.

Francis, R.I.C.C. (2009). SurvCalc User Manual. 39 p. (Unpublished report held at NIWA, Wellington.)

Heath, R.A. (1975). Oceanic circulation and hydrology off the southern half of South Island, New Zealand. *New Zealand Oceanographic Institute Memoir 72*. 36 p.

Horn, P.L. (1993). Growth, age structure, and productivity of ling, *Genypterus blacodes* (Ophidiidae), in New Zealand waters. *New Zealand Journal of Marine and Freshwater Research 27:* 385–397.

Horn, P.L. (1997). An ageing methodology, growth parameters and estimates of mortality for hake (*Merluccius australis*) from around the South Island, New Zealand. *Marine and Freshwater Research 48:* 201–209.

Horn, P.L.; Sullivan, K.J. (1996). Validated aging methodology using otoliths, and growth parameters for hoki *(Macruronus novaezelandiae)* in New Zealand waters. *New Zealand Journal of Marine and Freshwater Research 30*: 161–174.

Hurst, R.J.; Bagley, N.W.; Chatterton, T.D.; Hanchet, S.M.; Schofield, K.A.; Vignaux, M. (1992). Standardisation of hoki/middle depth time series trawl surveys. MAF Fisheries Internal Report 194. 87 p. (Unpublished report held in NIWA library, Wellington.)

Ingerson, J.K.V.; Hanchet, S.M. (1995). Trawl survey of hoki and associated species in the Southland and Sub-Antarctic areas, November–December 1993 (TAN9310). *New Zealand Fisheries Data Report No. 67.* 44 p.

Ingerson, J.K.V.; Hanchet, S.M.; Chatterton, T.D. (1995). Trawl survey of hoki and associated species in the Southland and Sub-Antarctic areas, November–December 1992 (TAN9211). *New Zealand Fisheries Data Report No. 66.* 43 p.

Livingston, M.E.; Bull, B. (2000). The proportion of western stock hoki developing to spawn in April 1998. *New Zealand Fisheries Assessment Report 2000/13.* 20 p.

Livingston, M.E.; Bull, B.; Stevens, D.W. (2002a). Migration patterns during the life-cycle of hoki (*Macruronus novaezelandiae*): an analysis of trawl survey data in New Zealand waters 1991–2002. Final Research Report for Ministry of Fisheries Research Project HOK2000/01 Objective 6. (Unpublished report held by Ministry for Primary Industries, Wellington.)

Livingston, M.E.; Bull, B.; Stevens, D.W.; Bagley, N.W. (2002b). A review of hoki and middle depth trawl surveys of the Chatham Rise, January 1992–2001. *NIWA Technical Report 113.* 146 p.

Livingston, M.E.; Vignaux, M.; Schofield, K.A. (1997). Estimating the annual proportion of nonspawning adults in New Zealand hoki, *Macruronus novaezelandiae. Fishery Bulletin 95*: 99–113.

McMillan, P.J.; Francis, M.P.; James, G.D.; Paul, L.J.; Marriott, P.J.; Mackay, E.; Wood, B.A.; Griggs, L.H.; Sui, H.; Wei, F. (2011). A guide to common New Zealand trawl fishes. *New Zealand Aquatic Environment and Biodiversity Report No. 68*. 317 p.

O'Driscoll, R.L.; Bagley, N.W. (2001). Review of summer and autumn trawl survey time series from the Southland and Sub-Antarctic areas 1991–98. *NIWA Technical Report 102.* 115 p.

O'Driscoll, R.L.; Bagley, N.W.; Bull, B. (2002). Trawl survey of middle depth species in the Southland and Sub-Antarctic areas, November–December 2000 (TAN0012). *NIWA Technical Report 110.* 78 p.

O'Driscoll, R.L.; Bagley, N.W. (2003a). Trawl survey of middle depth species in the Southland and Sub-Antarctic areas, November–December 2001 (TAN0118). *New Zealand Fisheries Assessment Report 2003/1*. 53 p.

O'Driscoll, R.L.; Bagley, N.W. (2003b). Trawl survey of middle depth species in the Southland and Sub-Antarctic areas, November–December 2002 (TAN0219). *New Zealand Fisheries Assessment Report 2003/46*. 57 p.

O'Driscoll, R.L.; Bagley (2004). Trawl survey of hoki, hake, and ling in the Southland and Sub-Antarctic areas, November–December 2003 (TAN0317). *New Zealand Fisheries Assessment Report 2004/49*. 58 p.

O'Driscoll, R.L.; Bagley (2006a). Trawl survey of hoki, hake, and ling in the Southland and Sub-Antarctic areas, November–December 2004 (TAN0414). *New Zealand Fisheries Assessment Report 2006/2*. 60 p.

O'Driscoll, R.L.; Bagley, N.W. (2006b). Trawl survey of hoki, hake, and ling in the Southland and Sub-Antarctic areas, November–December 2005 (TAN0515). *New Zealand Fisheries Assessment Report 2006/45.* 64 p.

O'Driscoll, R.L.; Bagley, N.W. (2008). Trawl survey of middle depth species in the Southland and Sub-Antarctic areas, November–December 2006 (TAN0617). *New Zealand Fisheries Assessment Report 2008/30*. 61 p.

O'Driscoll, R.L.; Bagley, N.W. (2009). Trawl survey of middle depth species in the Southland and Sub-Antarctic areas, November–December 2008 (TAN0813). *New Zealand Fisheries Assessment Report 2009/56.* 67 p.

O'Driscoll, R.L.; MacGibbon, D.; Fu, D.; Lyon, W.; Stevens, D.W. (2011b). A review of hoki and middle depth trawl surveys of the Chatham Rise, January 1992–2010. *New Zealand Fisheries Assessment Report 2011/47.* 814 p.

Tracey, D.M.; Anderson, O.F.; Naylor, J.R. (Comps.) (2007). A guide to common deepsea invertebrates in New Zealand waters. Second edition. *New Zealand Aquatic Environment and Biodiversity Report No. 10.* 282 p.

Tuck, I., Cole, R., Devine, J. (2009). Ecosystem indicators for New Zealand fisheries. *New Zealand Aquatic Environment and Biodiversity Report 42*. 188 p.

Vignaux, M. (1994). Documentation of Trawlsurvey Analysis Program. MAF Fisheries Greta Point Internal Report No. 225. 44 p. (Unpublished report held in NIWA library, Wellington.)

7. TABLES

Table 1: Trip codes, survey dates and documentation for the summer time series surveys of the Sub-Antarctic.

Year	Trip code	Start date	End date	Reference
1991	TAN9105	12 Nov 1991	23 Dec 1991	Chatterton & Hanchet (1994)
1992	TAN9211	14 Nov 1992	22 Dec 1992	Ingerson et al. (1995)
1993	TAN9310	12 Nov 1993	20 Dec 1993	Ingerson & Hanchet (1995)
2000	TAN0012	25 Nov 2000	22 Dec 2000	O’Driscoll et al. (2002)
2001	TAN0118	19 Nov 2001	18 Dec 2001	O’Driscoll & Bagley (2003a)
2002	TAN0219	23 Nov 2002	22 Dec 2002	O’Driscoll & Bagley (2003b)
2003	TAN0317	12 Nov 2003	10 Dec 2003	O’Driscoll & Bagley (2004)
2004	TAN0414	24 Nov 2004	23 Dec 2004	O’Driscoll & Bagley (2006a)
2005	TAN0515	24 Nov 2005	23 Dec 2005	O’Driscoll & Bagley (2006b)
2006	TAN0617	24 Nov 2006	23 Dec 2006	O’Driscoll & Bagley (2008)
2007	TAN0714	25 Nov 2007	23 Dec 2007	Bagley et al. (2009)
2008	TAN0813	24 Nov 2008	23 Dec 2008	O’Driscoll & Bagley (2009)
2009	TAN0911	23 Nov 2009	24 Dec 2009	Bagley & O’Driscoll (2012)

Table 2: The number of completed valid biomass stations by stratum for the summer time series trawl surveys of the Sub-Antarctic. Stratum boundaries are shown in Figure 1. Shaded boxes indicate surveys in which strata were combined. Separate totals are given for the core strata and for all strata.

Stratum number	Depth range (m)	Location	Area (km^2)	1992	1993	1994		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	300–600	Puysegur Bank	2 150	7	3	3		4	4	6	4	9	5	6	4	4	4
2	600–800	Puysegur Bank	1 318	3	3	4		4	4	5	4	4	5	4	4	4	4
3a*	300–600	Stewart-Snares	4 548					4	4	5	3	3	3	4	8	5	5
3b	300–600	Stewart-Snares	1 556	8	6	8		4	4	4	3	4	4	4	3	4	4
4	600–800	Stewart-Snares	21 018	9	13	10		5	5	5	3	4	5	4	5	6	5
5a*	600–800	Snares-Auckland	2 981					5	4	4	3	4	7	5	4	4	5
5b	600–800	Snares-Auckland	3 281	4	6	6		3	3	4	3	4	4	4	4	4	4
6	300–600	Auckland Is.	16 682	8	9	6		6	5	6	4	4	4	3	5	4	4
7	600–800	South Auckland	8 497	5	7	5		3	3	4	3	3	3	3	3	3	4
8	600–800	N.E. Auckland	17 294	15	15	12		8	8	5	3	5	6	7	5	4	5
9	300–600	N. Campbell Is.	27 398	14	15	11		10	8	9	9	10	8	8	8	6	6
10	600–800	S. Campbell Is.	11 288	11	8	9		4	4	3	3	3	3	3	4	3	3
11	600–800	N.E. Pukaki Rise	23 008	9	9	7		5	4	4	4	3	3	3	4	7	6
12	300–600	Pukaki	45 259	21	20	13		5	10	8	8	7	7	7	8	7	6
13	300–600	N.E. Camp. Plateau	36 051	12	11	13		6	6	6	5	4	4	4	5	4	3
14	300–600	E. Camp. Plateau	27 659	15	16	17		5	5	4	4	3	3	3	3	3	3
15	600–800	E. Camp. Plateau	15 179	9	8	6		3	4	3	3	3	3	3	3	3	3
25	800–1 000	Puysegur Bank	1 928	4	6	4		4	7	9	4	4	7	9	8	8	6
Total (core strata)			**265 167**	**154**	**155**	**134**	**0**	**88**	**92**	**94**	**73**	**81**	**84**	**84**	**88**	**83**	**80**
17	300–600	Bounty Platform	11 360	0	5	4		-	-	-	-	-	-	-	-	-	-
26	800–1 000	S.W. Campbell Is.	31 778	-	-	-		3	4	3	0	0	2	0	3	3	3
27	800–1 000	N.E. Pukaki Rise	12 986	-	-	-		5	6	5	5	3	6	3	3	3	3
28	800–1 000	E. Stewart Is.	8 336	-	-	-		4	4	3	3	3	4	4	4	4	4
Total			**329 627**	**154**	**160**	**138**		**103**	**106**	**105**	**81**	**90**	**96**	**91**	**98**	**95**	**90**

Table 3: Biological species or groups recorded on all Sub-Antarctic summer time series trawl surveys 1991–1993 and 2000–2009. Note that data are from all valid biomass stations only. Rubbish and 'other' codes are also included.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
ACA	*Acanthephyra* spp.	*Acanthephyra* spp	Crustacean	PRA	7.0	-	-	6
ACO	*Araeosoma coriaceum*	Tam O shanter urchin	Echinoderm	ECN	14.9	-	-	2
ACS	Actinostolidae	Deepsea anemone	Cnidaria	ANT	172.1	-	-	8
AER	*Aeneator recens*	*Aeneator recens*	Mollusc	GAS	0.1	-	-	1
AFO	*Aristaeomorpha foliacea*	Royal red prawn	Crustacean	PRA	0.3	-	-	2
AGI	*Argyropelecus gigas*	Giant hatchetfish	Teleost	-	0.8	-	-	5
AGR	*Agrostichthys parkeri*	Ribbonfish	Teleost	-	17.9	-	-	7
AMA	*Acesta maui*	*Acesta maui*	Mollusc	-	1.0	-	-	1
AMP	*Amphitretus* sp.	Deepwater octopod	Cephalopod	-	43.8	-	-	3
ANO	*Anoplogaster cornuta*	Fangtooth	Teleost	-	0.3	-	-	2
ANT	Anthozoa	Anemones	Cnidaria	ANT	729.8	-	-	12
APE	*Acanthephyra pelagica*	*Acanthephyra pelagica*	Crustacean	PRA	0.4	-	-	2
API	*Alertichthys blacki*	Alert pigfish	Teleost	-	2.6	-	-	10
APR	*Apristurus* spp.	Catshark	Elasmobranch	-	123.4	38	25	11
APU	*Aciculites pulchra*	Maroon pimpled ear sponge	Porifera	ONG	0.2	-	-	1
ARA	*Araeosoma* spp.	Tam O shanter urchin	Echinoderm	ECN	36.6	-	-	3
ARI	*Aristeus* sp.	*Aristeus* sp	Crustacean	PRA	0.3	-	-	2
ASC	Ascidiacea	Sea squirt	Other		4.2	-	-	3
ASR		Asteroid (starfish)	Echinoderm	SFI	76.7	-	-	9
AST	Astronesthidae	Snaggletooths	Teleost	-	1.2	-	-	4
AWI	*Alcithoe wilsonae*	*Alcithoe wilsonae*	Mollusc	GAS	0.3	-	-	2
BAA	*Bathylagus antarcticus*	Deepsea smelt	Teleost	-	0.4	-	-	1
BAC	*Bathygadus cottoides*	Codheaded rattail	Teleost	-	75.5	-	-	1
BAF		Black anglerfish	Teleost	-	0.9	-	-	1
BAM	*Bathyplotes moseleyi*	*Bathyplotes moseleyi*	Echinoderm	HTH	1.5	-	-	4
BAN	*Borostomias antarcticus*	*Borostomias antarcticus*	Teleost	-	0.1	-	-	1
BAR	*Thyrsites atun*	Barracouta	Teleost	-	21.7	14	1	2
BAT	*Rouleina* spp.	Slickheads	Teleost	-	0.2	-	-	1
BBA	*Nesiarchus nasutus*	Black barracouta	Teleost	-	0.3	-	-	1
BBE	*Centriscops humerosus*	Banded bellowsfish	Teleost	-	55.6	1	1	12
BBR	*Xenobrama microlepis*	Bronze bream	Teleost	RBM	11.8	4	3	4
BCA	*Magnisudis prionosa*	Barracudina	Teleost	-	11.8	-	-	6

Table 3 continued: Biological species or groups recorded on all Sub-Antarctic summer time series trawl surveys.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
BCH	*Brisinga chathamica*	*Brisinga chathamica*	Echinoderm	SFI	0.9	-	-	1
BEE	*Diastobranchus capensis*	Basketwork eel	Teleost	-	1354.3	437	319	13
BEN	*Benthodesmus* spp.	Scabbardfish	Teleost		0.1	-	-	1
BER	*Typhlonarke* spp.	Numbfish	Elasmobranch	-	1.9	-	-	2
BES	*Benthopecten* spp.	Benthopecten spp.	Echinoderm	SFI	0.5	-	-	4
BGZ	*Kathetostoma binigrasella*	Banded giant stargazer	Teleost	-	60.4	19	12	5
BJA	*Mesobius antipodum*	Black javelinfish	Teleost	-	237.7	159	131	10
BMO	*Borostomias mononema*	Borostomias mononema	Teleost	-	1.6	-	-	3
BNE	*Benthodesmus elongatus*	Scabbard fish	Teleost		2.6	-	-	4
BNO	*Benthoctopus* spp.	*Benthoctopus* spp.	Cephalopod	-	1.3	-	-	1
BNS	*Hyperoglyphe antarctica*	Bluenose	Teleost	-	332.2	23	20	8
BNT	*Benthodesmus tenuis*	Scabbard fish	Teleost		0.6	-	-	2
BOC	*Bolocera* spp.	Deepsea anemone	Cnidaria	ANT	4.9	-	-	5
BOE	*Allocyttus niger*	Black oreo	Teleost	-	28 063.7	7 816	2 747	12
BOO	*Keratoisis* spp.	Bamboo coral	Cnidaria	COU	0.4	-	-	1
BPI	*Benthopecten pikei*	Benthopecten pikei	Echinoderm	SFI	0.3	-	-	1
BRC	*Pseudophycis breviuscula*	Northern bastard cod	Teleost	-	1.9	-	-	1
BRG	Brisingida	Brisingida	Echinoderm	SFI	2.1	-	-	3
BSH	*Dalatias licha*	Seal shark	Elasmobranch	-	1 148.2	186	150	13
BSL	*Xenodermichthys* spp.	Black slickhead	Teleost	-	28.3	-	-	2
BSP	*Taratichthys longipinnis*	Big-scale pomfret	Teleost	-	0.7	-	-	1
BTA	*Notoraja asperula*	Smooth deepsea skate	Elasmobranch	BTH	90.6	4	4	13
BTH	*Notoraja* spp.	Bluntnose skates deepsea skates	Elasmobranch	BTH	43.6	-	-	6
BTM	*Bathymodiolus* spp.	*Bathymodiolus* spp	Mollusc	-	0.1	-	-	1
BTS	*Notoraja spinifera*	Prickly deepsea skate	Elasmobranch	BTH	103.1	1	1	13
BYS	*Beryx splendens*	Alfonsino	Teleost	-	1.9	2	2	2
CAM	*Camplyonotus rathbunae*	Sabre prawn	Crustacean	PRA	3.9	-	-	8
CAR	*Cephaloscyllium isabellum*	Carpet shark	Elasmobranch	-	2.8	1	1	1
CAS	*Coelorinchus aspercephalus*	Oblique banded rattail	Teleost	-	4 468.1	6 986	2 924	13
CBA	*Coryphaenoides dossenus*	Humpback rattail (slender rattail)	Teleost	-	141.2	19	18	12
CBI	*Coelorinchus biclinozonalis*	Two saddle rattail	Teleost	-	30.7	51	1	6
CBO	*Coelorinchus bollonsi*	Bollons rattail	Teleost	-	2 726.1	1 435	1 012	13

Table 3 continued: Biological species or groups recorded on all Sub-Antarctic summer time series trawl surveys.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
CCX	*Coelorinchus parvifasciatus*	Small banded rattail	Teleost	-	40.5	111	12	8
CDO	*Capromimus abbreviatus*	Capro dory	Teleost	-	15.2	-	-	9
CDX	*Coelorinchus maurofasciatus*	Dark banded rattail	Teleost	-	0.7	2	-	1
CDY	*Cosmasterias dyscrita*	Cosmasterias dyscrita	Echinoderm	SFI	1.6	-	-	4
CEX	*Coelorinchus celaenostomus*	Black lip rattail	Teleost	-	0.8	-	-	1
CFA	*Coelorinchus fasciatus*	Banded rattail	Teleost	-	3 145.9	15 554	4 690	13
CFX	*Coelorinchus supernasutus*	Supanose rattail	Teleost	-	1.1	-	-	1
CHA	*Chauliodus sloani*	Viper fish	Teleost	-	11.4	-	-	10
CHG	*Chimaera lignaria*	Giant chimaera	Elasmobranch	-	223.1	7	7	8
CHP	*Chimaera* sp.	Chimaera, brown	Elasmobranch	-	57.5	11	10	8
CHQ	*Cranchiidae*	Cranchiid squid	Cephalopod	SQX	3.0	-	-	6
CIC	*Crella incrustans*	Orange frond sponge	Porifera	ONG	3.4	-	-	1
CID	Cidaridae	Cidarid urchin	Echinoderm	ECN	0.5	-	-	1
CIN	*Coelorinchus innotabilis*	Notable rattail	Teleost	-	127.2	647	193	13
CJA	*Crossaster multispinus*	Sun star	Echinoderm	SFI	6.4	-	-	9
CJX	*Coelorinchus mycterismus*	Upturned snout rattail	Teleost	-	0.2	-	-	1
CKA	*Coelorinchus kaiyomaru*	Kaiyomaru rattail	Teleost	-	101.5	322	197	13
CKX	*Coelorinchus trachycarus* & *C. acanthiger*	Spottyfaced rattails (roughhead)	Teleost	-	4.9	-	-	3
CMA	*Coelorinchus matamua*	Mahia rattail	Teleost	-	106.5	37	11	13
CMP	*Cheiraster monopedicellaris*	Cheiraster monopedicellaris	Echinoderm	SFI	0.2	-	-	1
CMU	*Coryphaenoides murrayi*	Abyssal rattail	Teleost	-	100.8	2	2	6
CNI	*Chiasmodon niger*	Black swallower	Teleost	-	0.4	-	-	2
CNL	*Craniella* spp.	Craniella spp.	Porifera		0.1	-	-	1
COB	Antipatharia (Order)	Black coral	Cnidaria	COU	0.1	-	-	1
COF	*Flabellum* spp.	Flabellum coral	Cnidaria	COU	0.9	-	-	4
COL	*Coelorinchus oliverianus*	Olivers rattail	Teleost	-	5 343.4	18 205	3 274	13
COT	*Cottunculus nudus*	Bonyskull toadfish	Teleost	-	6.0	-	-	5
COU		Coral (unspecified)	Cnidaria	COU	18.1	-	-	7
CPA	*Ceramaster patagonicus*	Pentagon star	Echinoderm	SFI	38.1	-	-	7
CPG	*Callispongia* sp.	Callispongia sp	Porifera	ONG	0.5	-	-	1
CRB		Crab (unspecified)	Crustacean	CRB	8.0	-	-	11
CRD	*Coryphaenoides rudis*	Coryphaenoides rudis	Teleost	-	5.4	-	-	1

Table 3 continued: Biological species or groups recorded on all Sub-Antarctic summer time series trawl surveys.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
CRE	*Calyptopora reticulata*	White hydrocoral	Cnidaria	COU	0.1	-	-	1
CRI	Crinoidea	Sea lilies	Echinoderm	-	0.2	-	-	1
CRM	*Callyspongia cf ramosa*	Airy finger sponge	Porifera	ONG	1.0	-	-	2
CRS	*Callyspongia ramosa*	Airy finger sponge	Porifera	ONG	2.0	-	-	1
CRU		Crustacea	Crustacean	-	0.4	-	-	2
CSE	*Coryphaenoides serrulatus*	Serrulate rattail	Teleost	-	178.0	225	76	12
CSQ	*Centrophorus squamosus*	Leafscale gulper shark	Elasmobranch	-	6 516.6	730	607	13
CSU	*Coryphaenoides subserrulatus*	Four-rayed rattail	Teleost	-	2 165.4	7 444	1 589	13
CTR	*Coryphaenoides striaturus*	Abyssal rattail	Teleost	-	0.3	-	-	1
CVI	*Carcinoplax victoriensis*	Two-spined crab	Crustacean	CRB	0.1	-	-	1
CYL	*Centroscymnus coelolepis*	Centroscymnus coelolepis	Elasmobranch	-	32.6	-	-	4
CYO	*Centroscymnus owstoni*	Smooth skin dogfish	Elasmobranch	-	1 244.6	406	240	12
CYP	*Centroscymnus crepidater*	Longnose velvet dogfish	Elasmobranch	-	13 706.3	3 537	2 165	13
DCO	*Notophycis marginata*	Dwarf cod	Teleost	-	7.9	-	-	12
DCS	*Halaelurus dawsoni*	Dawsons catshark	Elasmobranch	-	21.1	16	15	12
DDI	*Desmophyllum dianthus*	Desmophyllum dianthus	Cnidaria	COU	0.2	-	-	1
DEA	*Trachipterus trachypterus*	Dealfish	Teleost	-	133.6	-	-	9
DEQ*	*Deania quadrispinosum*	Deania quadrispinosum	Elasmobranch	SND	1 053.2	-	-	1
DHO	*Dermechinus horridus*	Sea urchin	Echinoderm	ECN	5.2	-	-	3
DIA	*Diaphus* spp.	Diaphus spp	Teleost	LAN	0.4	-	-	3
DIP	*Diplophos* spp.	Diplophos spp	Teleost	-	0.7	-	-	3
DIS	*Diretmus argenteus*	Discfish	Teleost	-	4.4	-	-	11
DMG	*Dipsacaster magnificus*	Dipsacaster magnificus	Echinoderm	SFI	48.1	-	-	8
DPP	*Diplopteraster* sp.	Diplopteraster sp.	Echinoderm	SFI	3.4	-	-	3
DSK	*Amblyraja hyperborea*	Deepwater spiny skate (arctic skate)	Elasmobranch	-	26.9	-	-	2
DSO	Demospongiae (Class)	Demosponges	Porifera	ONG	0.2	-	-	1
DSP	*Congiopodus coriaceus*	Deepsea pigfish	Teleost	-	19.9	-	-	4
DSS	*Bathylagus* spp.	Deepsea smelt	Teleost	-	5.5	-	-	9
DWD		Deepwater dogfish	Elasmobranch	-	0.7	-	-	1
DWO	*Graneledone* spp.	Deepwater octopus	Cephalopod	-	266.0	-	-	12
EBA	*Echiostoma barbatum*	Echiostoma barbatum	Teleost	-	0.2	-	-	1

* DEQ were only identified during the 1992 survey, and these are combined with shovelnose dogfish (SND).

Table 3 continued: Biological species or groups recorded on all Sub-Antarctic summer time series trawl surveys.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
ECH		Echinodermata	Echinoderm	ECN	18.0	-	-	5
ECN		Echinoid (sea urchin)	Echinoderm	ECN	12.1	-	-	5
ECR	*Echiodon cryomargarites*	Messmate fish	Teleost		1.7	-	-	5
ECT	Echinothuriidae (family)	Echinothuriidae (family)	Echinoderm	ECN	0.6	-	-	1
EGC		Egg case	Other		0.8	-	-	4
EPL	*Epigonus lenimen*	Bigeye cardinalfish	Teleost	CDL	358.6	131	33	12
EPR	*Epigonus robustus*	Robust cardinalfish	Teleost	CDL	6.5	6	1	10
EPT	*Epigonus telescopus*	Deepsea cardinalfish	Teleost		120.5	338	166	12
EPZ	*Epizoanthus* sp.	Epizoanthus sp.	Cnidaria		0.3	-	-	2
ERA	*Torpedo fairchildi*	Electric ray	Elasmobranch		5.9	-	-	1
ERE	*Euplectella regalis*	Basket-weave horn sponge	Porifera	ONG	1.1	-	-	1
ERR	*Errina* spp.	Red coral	Cnidaria	COU	0.1	-	-	1
ETB	*Etmopterus baxteri*	Baxters lantern dogfish	Elasmobranch	-	6 209.4	3 306	2 662	13
ETL	*Etmopterus lucifer*	Lucifer dogfish	Elasmobranch	-	1 206.3	1 673	778	13
ETP	*Etmopterus pusillus*	Etmopterus pusillus	Elasmobranch	-	0.4	-	-	1
EUC	*Euclichthys polynemus*	Eucla cod	Teleost	-	1.9	-	-	1
EZE	*Enteroctopus zealandicus*	Yellow octopus	Cephalopod	OCP	16.8	-	-	5
FAN	*Pterycombus petersii*	Fanfish	Teleost	-	1.8	-	-	1
FHD	*Hoplichthys haswelli*	Deepsea flathead	Teleost	-	19.5	-	-	10
FIS	Fish unidentified	Fish unidentified	Teleost	-	0.4	-	-	3
FMA	*Fusitriton magellanicus*	Fusitriton magellanicus	Mollusc	GAS	13.8	-	-	8
FRO	*Lepidopus caudatus*	Frostfish	Teleost	-	2.3	1	1	1
FUN	*Funchalia* spp.	Funchalia spp	Crustacean	PRA	0.1	-	-	1
GAS	Gastropoda	Gastropods	Mollusc	GAS	15.0	-	-	8
GEL	*Gonostoma elongatum*	Elongate lightfish	Teleost	-	0.2	-	-	1
GLS	Hexactinellida (Class)	Glass sponges	Porifera	ONG	2032.1	-	-	4
GMC	*Leptomithrax garricki*	Garrick's masking crab	Crustacean	CRB	0.6	-	-	1
GNO	*Gadella norops*	Morid cod	Teleost	-	0.3	-	-	1
GOC	Gorgonacea (Order)	Gorgonian coral	Cnidaria	COU	0.7	-	-	4
GON	*Gonorynchus forsteri* & *G. greyi*	Gonorynchus forsteri & G. Greyi	Teleost	-	6.7	-	-	5
GOR	*Gorgonocephalus* spp.	Gorgonocephalus spp	Echinoderm	SFI	4.6	-	-	7
GOU	*Goniocidaris umbraculum*	Cidarid urchin	Echinoderm	ECN	1.7	-	-	4

Table 3 continued: Biological species or groups recorded on all Sub-Antarctic summer time series trawl surveys.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
GPA	*Goniocidaris parasol*	Sea urchin	Echinoderm	ECN	7.6	-	-	9
GRC	*Tripterophycis gilchristi*	Grenadier cod	Teleost	-	0.8	-	-	5
GRM	*Gracilechinus multidentatus*	Sea urchin	Echinoderm	ECN	22.0	-	-	7
GSC	*Jacquinotia edwardsii*	Giant spider crab	Crustacean	GSC	102.1	-	-	10
GSH	*Hydrolagus novaezealandiae*	Ghost shark	Elasmobranch	-	4 720.3	4 004	2 217	13
GSP	*Hydrolagus bemisi*	Pale ghost shark	Elasmobranch	-	28 903.9	14 919	9 578	13
GSQ	*Architeuthis* spp.	Giant squid	Cephalopod	-	120.0	-	-	1
GST	Gonostomatidae	Gonostomatidae	Teleost	-	0.5	-	-	2
GVE	*Geodinella vestigifera*	Convoluted ostrich egg sponge	Porifera	ONG	8.7	-	-	2
GVO	*Provocator mirabilis*	Golden volute	Mollusc	GAS	1.3	-	-	4
GYM	*Gymnoscopelus* spp.	Gymnoscopelus spp	Teleost	LAN	1.8	-	-	3
GYP	*Gymnoscopelus piabilis*	Lanternfish	Teleost	LAN	0.1	-	-	1
GYS	*Gyrophyllum sibogae*	Siboga sea pen	Cnidaria	-	0.2	-	-	1
HAG	*Eptatretus cirrhatus*	Hagfish	Teleost	-	3.5	-	-	2
HAK	*Merluccius australis*	Hake	Teleost	-	27 751.0	7 721	6 782	13
HAP	*Polyprion oxygeneios*	Hapuku	Teleost	-	186.9	20	17	10
HAT	Sternoptychidae	Hatchetfish	Teleost	-	0.4	-	-	3
HCO	*Bassanago hirsutus*	Hairy conger	Teleost	-	1 103.1	103	91	13
HDR	Hydrozoa (Class)	Hydroid	Cnidaria	COU	0.2	-	-	2
HEC	*Henricia compacta*	Henricia compacta	Echinoderm	SFI	0.8	-	-	3
HIS	*Histocidaris* spp.	Histocidaris spp.	Echinoderm	ECN	0.7	-	-	2
HJO	*Halargyreus johnsonii*	Johnson's cod	Teleost	-	296.2	331	173	12
HMT	Hormathiidae	Deepsea anemone	Cnidaria	ANT	61.1	-	-	8
HOK	*Macruronus novaezelandiae*	Hoki	Teleost	-	222407.1	109 426	20 637	13
HOL	*Holtbyrnia* sp.	Tubeshoulder	Teleost	-	3.3	-	-	3
HSI	*Haliporoides sibogae*	Jackknife prawn	Crustacean	PRA	0.2	-	-	2
HTH	Holothurian unidentified	Sea cucumber	Echinoderm	HTH	286.0	-	-	7
HTR	*Hippasteria phrygiana*	Trojan starfish	Echinoderm	SFI	205.0	-	-	10
HYA	*Hyalascus* sp.	Floppy tubular sponge	Porifera	ONG	1 558.5	-	-	3
HYP	*Hydrolagus trolli*	Pointynose blue ghost shark	Elasmobranch	-	6.4	3	3	1
IDI	*Idiacanthus* spp.	Black dragonfishes	Teleost	-	2.9	-	-	9
ISI	Isididae	Bamboo corals	Cnidaria	COU	0.2	-	-	1

Table 3 continued: Biological species or groups recorded on all Sub-Antarctic summer time series trawl surveys.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
ISO		Isopod	Crustacean	-	0.2	-	-	1
JAV	*Lepidorhynchus denticulatus*	Javelin fish	Teleost	-	54 876.8	56 703	8 007	13
JFI		Jellyfish	Cnidaria	-	386.0	-	-	12
JMM	*Trachurus murphyi*	Slender jack mackerel	Teleost	-	1.4	1	-	1
KAI	*Kali indica*	Kali indica	Teleost	-	0.1	-	-	1
KBB	*Macrocystis pyrifera*	Bladder kelp	Algae	-	0.1	-	-	1
KCU	*Paralomis aculeala*	Red stone crab	Crustacean	CRB	1.6	-	-	1
LAE	*Laemonema* spp.	Laemonema spp	Teleost	-	47.9	6	6	5
LAN	Myctophidae	Lantern fish	Teleost	LAN	12.8	-	-	11
LCH	*Harriotta raleighana*	Long-nosed chimaera	Elasmobranch	-	2 550.9	560	508	13
LDO	*Cyttus traversi*	Lookdown dory	Teleost	-	2 646.3	2 196	1 403	13
LEG	*Lepidion schmidti* & *Lepidion inosimae*	Giant lepidion	Teleost	-	17.2	-	-	1
LHE	*Lampanyctodes hectoris*	Lampanyctodes hectoris	Teleost	LAN	0.2	-	-	2
LHO	*Lipkius holthuisi*	Lipkius holthuisi	Crustacean	-	104.2	-	-	13
LIN	*Genypterus blacodes*	Ling	Teleost	-	105 455.3	34 563	17 471	13
LIP	*Liponema* spp.	Deepsea anemone	Cnidaria	ANT	3.4	-	-	4
LLE	*Lepidisis* spp.	Bamboo coral	Cnidaria	COU	0.1	-	-	1
LLT	*Lithodes* cf. *longispinus*	Long-spined king crab	Crustacean	CRB	6.4	-	-	3
LMU	*Lithodes aotearoa*	New Zealand King Crab	Crustacean	-	234.3	-	-	13
LNV	*Lithosoma novaezelandiae*	Rock star	Echinoderm	SFI	9.5	-	-	6
LPA	*Lampanyctus* spp.	Lampanyctus spp	Teleost	LAN	7.2	-	-	6
LPD	*Lampadena* spp.	Lampadena spp	Teleost	LAN	0.4	-	-	2
LYC	*Lyconus* spp		Teleost	-	22.3	1	1	9
MAK	*Isurus oxyrinchus*	Mako shark	Elasmobranch	-	70.0	-	-	1
MAL	Malacosteidae	Loosejaw	Teleost	-	1.0	-	-	8
MAN	*Neoachiropsetta milfordi*	Finless flounder	Teleost	-	1 661.8	198	178	13
MAT	*Mediaster arcuatus*	Mediaster arcuatus	Echinoderm	SFI	0.1	-	-	1
MBE	*Opisthoproctus grimaldii*	Mirrorbelly	Teleost	-	0.2	-	-	1
MCA	*Macrourus carinatus*	Ridge scaled rattail	Teleost	-	11 069.1	5 536	3 321	13
MCC	*Malluvium calcareum*	Cap limpet	Mollusc	-	1.2	-	-	3
MEN	*Melanostomias* spp.	Melanostomias spp	Teleost	-	0.8	-	-	3
MIQ	*Onyika ingens*	Warty squid	Cephalopod	WSQ	4 578.1	235	105	12

Table 3 continued: Biological species or groups recorded on all Sub-Antarctic summer time series trawl surveys.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
MNI	*Munida* spp.	Munida unidentified	Crustacean	-	0.2	-	-	2
MOL		Molluscs	Mollusc	-	0.8	-	-	2
MOO	*Lampris guttatus*	Moonfish	Teleost	-	11.4	1	-	1
MPH	Melamphaidae	Big-scale fish	Teleost	-	0.4	-	-	1
MRL	Muraenolepididae	Moray cods	Teleost	-	0.5	-	-	1
MRQ	*Onyika robsoni*	Warty squid	Cephalopod	WSQ	572.9	4	4	12
MSL	*Mediaster sladeni*	Starfish	Echinoderm	SFI	2.9	-	-	5
MST	Melanostomiidae	Melanostomiidae	Teleost	-	0.9	-	-	4
MUN	*Munida gregaria*	Munida gregaria	Crustacean	-	0.1	-	-	1
MYX	*Myxilla* spp.	Myxilla spp.	Porifera	ONG	0.1	-	-	1
NAN	*Nansenia* spp.	Deepsea smelt	Teleost	-	0.6	-	-	2
NAU	*Notostomus auriculatus*	Notostomus auriculatus	Crustacean	PRA	0.2	-	-	2
NCB	*Nectocarcinus bennetti*	Smooth red swimming crab	Crustacean	CRB	0.7	-	-	2
NCO	*Notoscopelus* spp.	Notoscopelus spp.	Teleost	-	0.5	-	-	1
NEB	*Neolithodes brodiei*	Brodie's king crab	Crustacean	-	95.9	-	-	11
NEC	*Nematocarcinus* spp.	Nematocarcinus spp.	Crustacean	CRB	0.1	-	-	1
NEI	*Neognathophausia ingens*	Giant red mysid	Crustacean	-	0.3	-	-	2
NEM	*Nemichthys scolopaceus*	Slender snipe eel	Teleost	-	0.2	-	-	2
NEX	Nemichthyidae	Snipe eels	Teleost	-	0.3	-	-	2
NMA	*Notopandalus magnoculus*	Prawn	Crustacean	PRA	0.1	-	-	1
NNA	*Nezumia namatahi*	Nezumia namatahi	Teleost	-	5.3	-	-	4
NOC	*Notocanthus chemnitzi*	Notocanthus chemnitzi	Teleost	-	1.5	-	-	1
NOS	*Nototodarus sloanii*	NZ southern arrow squid	Cephalopod	-	6 990.8	5 801	1 214	13
NUD	Nudibranchia	Nudibranchia	Mollusc	-	0.4	-	-	4
OAR	*Regalecus glesne*	Oarfish	Teleost	-	0.6	-	-	1
OBE	*Ogmocidaris benhami*	Cidarid urchin	Echinoderm	ECN	0.1	-	-	1
OCP		Octopod	Cephalopod	OCP	0.7	-	-	1
OCT	*Pinnoctopus cordiformis*	Octopus	Cephalopod	OCP	7.8	-	-	2
ODN	*Odontostomops normalops*	Sabretooth	Teleost	-	0.3	-	-	1
ODT	*Odontaster* spp.	Pentagonal tooth-star	Echinoderm	SFI	6.2	-	-	6
OHU	*Octopus huttoni*	Octopus huttoni	Cephalopod	OCP	0.1	-	-	1
OMI	*Opostomias micripnus*	Opostomias micripnus	Teleost	-	1.7	-	-	3

Table 3 continued: Biological species or groups recorded on all Sub-Antarctic summer time series trawl surveys.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
OMO	*Omosudis lowei*	Omosudis lowei	Teleost	-	0.3	-	-	1
ONG	Porifera (Phylum)	Sponges	Porifera	ONG	2 169.1	-	-	12
ONO	*Oplophorus novaezeelandiae*	Oplophorus novaezeelandiae	Crustacean	PRA	1.5	-	-	6
OPA	*Hemerocoetes* spp.	Opalfish	Teleost	-	1.0	-	-	5
OPH		Ophiuroid (brittle star)	Echinoderm	SFI	0.3	-	-	2
OPI	*Opisthoteuthis* spp.	Umbrella octopus	Cephalopod	-	159.3	-	-	13
OPP	*Oplophorus* spp.	Oplophorus spp.	Crustacean	PRA	0.2	-	-	2
ORH	*Hoplostethus atlanticus*	Orange roughy	Teleost	-	1 511.7	2 848	1 842	13
OSD	Selachii	Other sharks and dogs	Elasmobranch	CSQ	23.2	-	-	1
OSQ	Octopoteuthiid squids	Octopoteuthiidae	Cephalopod	OSQ	90.2	-	-	8
PAB	*Paragorgia arborea*	Bubblegum coral	Cnidaria	COU	0.3	-	-	2
PAG	Paguroidea	Pagurid	Crustacean	CRB	2.2	-	-	6
PAH	*Lampris immaculatus*	Opah	Teleost	-	14.9	-	-	1
PAL	Paralepididae	Barracudinas	Teleost	-	3.7	-	-	6
PAM	*Pannychia moseleyi*	Pannychia moseleyi	Echinoderm	HTH	0.3	-	-	1
PAO	*Pillsburiaster aoteanus*	Pillsburiaster aoteanus	Echinoderm	SFI	12.9	-	-	6
PAS	*Pasiphaea* spp.	Pasiphaea spp	Crustacean	PRA	9.4	-	-	8
PAZ	*Pachymatisma* spp.	Pachymatisma spp.	Porifera	ONG	1.5	-	-	1
PBA	*Pasiphaea barnardi*	Pasiphaea barnardi	Crustacean	PRA	9.5	-	-	7
PCD	*Poriocidaris purpurata*	Cidarid urchin	Echinoderm	ECN	0.9	-	-	4
PDG	*Oxynotus bruniensis*	Prickly dogfish	Elasmobranch	-	65.5	8	8	11
PDS	*Paradiplospinus gracilis*	False frostfish	Teleost	-	0.8	-	-	2
PED	*Aristaeopsis edwardsiana*	Scarlet prawn	Crustacean	PRA	0.6	-	-	5
PEM	*Perissasterias monacantha*	Perissasterias monacantha	Echinoderm	-	0.8	-	-	1
PER	*Persparsia kopua*	Persparsia kopua	Teleost	-	2.8	-	-	8
PHB	*Phorbas* spp.	Grey fibrous massive sponge	Porifera	ONG	6.7	-	-	5
PHM	*Phormosoma* spp.	Phormosoma spp.	Echinoderm	SFI	2.3	-	-	1
PHO	*Photichthys argenteus*	Lighthouse fish	Teleost	LAN	31.0	1	-	12
PHS	*Paralomis hystrix*	Paralomis hystrix	Crustacean	CRB	9.7	-	-	4
PHW	*Psammocinia* cf *hawere*	Psammocinia cf hawere	Porifera	ONG	2.1	-	-	2
PLI	*Peribolaster lictor*	Starfish	Echinoderm	SFI	0.4	-	-	2

* OSD are juvenile *Centrophorus squamosus* caught during the 1991 survey.

Table 3 continued: Biological species or groups recorded on all Sub-Antarctic summer time series trawl surveys.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
PLM	*Plesionika martia*	Plesionika martia	Crustacean	PRA	0.2	-	-	1
PLS	*Centroscymnus plunketi*	Plunkets shark	Elasmobranch	-	529.8	72	60	13
PLT	*Plutonaster* spp.	Plutonaster spp	Echinoderm	SFI	1.3	-	-	5
PLY	*Polycheles* spp.	Polychelidae	Crustacean	-	1.4	-	-	7
PMO	*Pseudostichopus mollis*	Pseudostichopus mollis	Echinoderm	HTH	202.9	-	-	4
PMU	*Paramaretia peloria*	Heart urchin	Echinoderm	ECN	1.3	-	-	3
PNE	*Proserpinaster neozelanicus*	Proserpinaster neozelanicus	Echinoderm	SFI	1.1	-	-	3
POL	Polychaeta	Polychaete	Other	-	0.2	-	-	2
POP	*Allomycterus jaculiferus*	Porcupine fish	Teleost	-	0.9	-	-	1
POS	*Lamna nasus*	Porbeagle shark	Elasmobranch	-	245.0	-	-	3
PRA		Prawn	Crustacean	PRA	2.0	-	-	4
PRO	*Protomyctophum* spp.	Protomyctophum spp	Teleost	LAN	0.2	-	-	2
PRU	*Pseudechinaster rubens*	Pseudechinaster rubens	Echinoderm	SFI	1.2	-	-	3
PSA	*Pseudechinus albocinctus*	Sea urchin	Echinoderm	ECN	0.1	-	-	1
PSI	*Psilaster acuminatus*	Geometric star	Echinoderm	SFI	16.9	-	-	9
PSK	*Bathyraja shuntovi*	Longnosed deepsea skate	Elasmobranch	-	102.0	1	1	12
PSQ	*Pholidoteuthis boschmai*	Pholidoteuthis boschmai	Cephalopod	-	5.7	-	-	2
PSY	*Psychrolutes microporos*	Psychrolutes	Teleost	-	247.5	-	-	10
PTA	*Pasiphaea* aff. *tarda*	Deepwater prawn	Crustacean	PRA	1.2	-	-	2
PTU	Pennatulacea (Order)	Sea pens	Cnidaria	PTU	0.4	-	-	2
PVE	*Pyramodon ventralis*	Pearlfish	Teleost	-	0.1	-	-	1
PYC	Pycnogonida	Sea spiders	Other	-	0.5	-	-	5
PYR	*Pyrosoma atlanticum*	Pyrosoma atlanticum	Other	SAL	5 309.5	-	-	5
PZE	*Paralomis zealandica*	Prickly king crab	Crustacean	CRB	10.9	-	-	7
RAG	*Icichthys australis*	Ragfish	Teleost	-	35.7	-	-	11
RAT	Macrouridae	Rattails	Teleost	-	12.9	-	-	4
RBM	*Brama brama*	Rays bream	Teleost	RBM	375.4	272	203	12
RBT	*Emmelichthys nitidus*	Redbait	Teleost	-	1.5	1	-	3
RCH	*Rhinochimaera pacifica*	Widenosed chimaera	Elasmobranch	-	1 160.0	282	196	12
RCO	*Pseudophycis bachus*	Red cod	Teleost	-	2 111.1	1 690	784	13
RGR	*Radiaster gracilis*	Radiaster gracilis	Echinoderm	SFI	0.5	-	-	3
RHY	*Paratrachichthys trailli*	Common roughy	Teleost	-	1.7	-	-	5

Table 3 continued: Biological species or groups recorded on all Sub-Antarctic summer time series trawl surveys.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
RIB	*Mora moro*	Ribaldo	Teleost	-	6 239.6	3 144	2 300	13
RIS	*Bathyraja richardsoni*	Richardson's skate	Elasmobranch	-	12.8	-	-	2
ROK	Geological specimens	Rocks stones	Other	-	191.7	-	-	3
ROS	*Rosenblattia robusta*	Rotund cardinalfish	Teleost	-	0.2	-	-	2
RSK	*Dipturus nasutus*	Rough skate	Elasmobranch	-	408.1	88	86	13
RSQ	*Ommastrephes bartrami*	Ommastrephes bartrami	Cephalopod	SQX	45.7	-	-	2
RUB		Rubbish other than fish	Other	-	1.6	-	-	2
RUD	*Centrolophus niger*	Rudderfish	Teleost	-	920.1	25	22	13
SAB	*Evermanella indica*	Sabretooth	Teleost	-	0.4	-	-	4
SAF	*Synaphobranchus affinis*	Grey cutthroat eel	Teleost	-	0.1	-	-	1
SAL		Salps	Other	SAL	772.2	-	-	10
SAW	*Serrivomer* sp.	Sawtooth eel	Teleost	-	0.5	-	-	3
SBI	*Alepocephalus* sp.	Slickhead, bigscaled brown	Teleost	-	38.3	11	-	4
SBK	*Notocanthus sexspinis*	Spineback	Teleost	-	1 830.9	593	391	13
SBO	*Pseudopentaceros richardsoni*	Southern boarfish	Teleost	-	0.2	-	-	1
SBR	*Pseudophycis barbata*	Southern bastard cod	Teleost	-	2.3	-	-	1
SBW	*Micromesistius australis*	Southern blue whiting	Teleost	-	20 490.2	26 981	8 437	13
SCC	*Stichopus mollis*	Sea cucumber	Echinoderm	HTH	505.9	-	-	6
SCD	*Paranotothenia microlepidota*	Smallscaled cod	Teleost	-	138.9	15	15	5
SCH	*Galeorhinus galeus*	School shark	Elasmobranch	-	421.2	29	21	9
SCI	*Metanephrops challengeri*	Scampi	Crustacean	-	24.0	119	116	11
SCM	*Centroscymnus macracanthus*	Largespine velvet dogfish	Elasmobranch	-	3.3	-	-	1
SCO	*Bassanago bulbiceps*	Swollenhead conger	Teleost	-	1 595.3	114	103	13
SDE	*Cryptopsaras couesi*	Seadevil	Teleost	-	0.6	-	-	3
SDF	*Azygopus pinnifasciatus*	Spotted flounder	Teleost	-	0.3	-	-	2
SDM	*Sympagurus dimorphus*	Pagurid	Crustacean	CRB	1.0	-	-	5
SDO	*Cyttus novaezealandiae*	Silver dory	Teleost	-	2 060.8	1 184	453	11
SEO		Seaweed	Algae	-	2.3	-	-	5
SEP	*Sergia potens*	Sergia potens	Crustacean	PRA	0.1	-	-	1
SEQ	Sepiolidae	Sepiolid squid	Cephalopod	SQX	0.1	-	-	1
SER	*Sergestes* spp.	Sergestes spp	Crustacean	PRA	0.4	-	-	2
SFI	*Asteroidea* & *Ophiuroidea*	Starfish	Echinoderm	SFI	265.3	-	-	7

Table 3 continued: Biological species or groups recorded on all Sub-Antarctic summer time series trawl surveys.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
SFN	*Diretmoides parini*	Spinyfin	Teleost	-	1.5	-	-	1
SHR	Aplysiomorpha (Order)	Sea hare	Mollusc	-	0.2	-	-	2
SID	Platytroctidae	Tubeshoulders	Teleost	-	0.6	-	-	2
SKA	Rajidae Arhynchobatidae (Families)	Skate	Elasmobranch	-	11.8	-	-	2
SKI	*Rexea solandri*	Gemfish	Teleost	-	219.2	66	27	12
SLT	*Stelletta* spp.	Stelletta spp.	Porifera	-	0.1	-	-	1
SMC	*Lepidion microcephalus*	Small-headed cod	Teleost	-	124.8	42	29	9
SMK	*Teratomaia richardsoni*	Spiny masking crab	Crustacean	CRB	1.2	-	-	6
SMO	*Sclerasterias mollis*	Cross-fish	Echinoderm	SFI	0.8	-	-	2
SND	*Deania calcea*	Shovelnose spiny dogfish	Elasmobranch	-	12 773.9	3 043	1 540	13
SOC	Alcyonacea (Order)	Soft coral	Cnidaria	COU	0.9	-	-	1
SOM	*Somniosus rostratus*	Little sleeper shark	Elasmobranch	-	16.9	-	-	1
SOR	*Neocyttus rhomboidalis*	Spiky oreo	Teleost	-	484.2	499	248	11
SOT	*Solaster torulatus*	Solaster torulatus	Echinoderm	SFI	15.4	-	-	9
SPA	*Sprattus antipodum*	Slender sprat	Teleost	-	1.6	-	-	1
SPD	*Squalus acanthias*	Spiny dogfish	Elasmobranch	-	20 862.6	7 772	4 740	13
SPE	*Helicolenus* spp.	Sea perch	Teleost	-	369.6	225	208	13
SPI		Spider crab	Crustacean	CRB	0.2	-	-	1
SPK	*Macrorhamphosodes uradoi*	Spikefish	Teleost	-	3.2	-	-	2
SPL	*Scopelosaurus* sp.	Scopelosaurus sp	Teleost	-	0.5	-	-	1
SPN		Sea pen	Cnidaria	PTU	0.4	-	-	2
SQU	*Nototodarus sloanii* & *N. gouldi*	Arrow squid	Cephalopod	SQX	0.7	1	-	1
SQX		Squid	Cephalopod	SQX	7.0	-	-	7
SRB	*Brama australis*	Southern rays bream	Teleost	RBM	70.3	38	22	5
SRH	*Hoplostethus mediterraneus*	Silver roughy	Teleost	-	22.7	-	-	12
SSC	*Leptomithrax australis*	Giant masking crab	Crustacean	GSC	162.1	-	-	9
SSH	*Gollum attenuatus*	Slender smooth-hound	Elasmobranch	-	7.5	4	4	4
SSI	*Argentina elongata*	Silverside	Teleost	-	2 522.6	11 348	3 951	13
SSK	*Dipturus innominatus*	Smooth skate	Elasmobranch	-	1 659.4	96	90	13
SSM	*Alepocephalus australis*	Slickhead, smallscaled brown	Teleost	-	5 389.1	2 739	1 631	11
SSO	*Pseudocyttus maculatus*	Smooth oreo	Teleost	-	10 674.9	6 658	3 451	13
STA	*Kathetostoma giganteum*	Giant stargazer	Teleost	-	3 827.9	1 077	734	13

Table 3 continued: Biological species or groups recorded on all Sub-Antarctic summer time series trawl surveys.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
STC	*Stereocidaris* spp.	Stereocidaris spp.	Echinoderm	ECN	0.1	-	-	1
STE	*Sternoptyx* spp.	Sternoptyx spp	Teleost	-	0.1	-	-	1
STO	*Stomias* spp.	Stomiatidae	Teleost	-	3.7	-	-	10
SUA	*Suberites affinis*	Fleshy club sponge	Porifera	ONG	12.1	-	-	5
SUH	*Schedophilus huttoni*	Schedophilus huttoni	Teleost	-	4.2	-	-	4
SUM	*Schedophilus maculatus*	Pelagic butterfish	Teleost	-	4.6	-	-	2
SUR	*Evechinus chloroticus*	Kina	Echinoderm	ECN	0.1	-	-	1
SUS	*Schedophilus* sp.	Schedophilus sp	Teleost	-	4.3	-	-	3
SWA	*Seriolella punctata*	Silver warehou	Teleost	-	10 719.2	1 775	652	13
SYM	*Symbolophorus* spp.	Lantern fish	Teleost	LAN	0.1	-	-	1
TAG	*Todarodes angolensis*	Todarodes angolensis	Cephalopod	SQX	1.7	1	-	1
TAM	*Echinothuriidae & Phormosomatidae*	Tam O shanter urchin	Echinoderm	ECN	451.4	-	-	10
TAR	*Nemadactylus macropterus*	Tarakihi	Teleost	-	17.2	10	-	1
TDQ	*Taningia danae*	Giant squid	Cephalopod	OSQ	8.4	-	-	3
TET	*Tetragonurus cuvieri*	Squaretail	Teleost	-	0.7	-	-	1
THN	*Thenea novaezelandiae*	Yoyo sponge	Porifera	ONG	0.1	-	-	1
THO	*Thouarella* spp.	Bottlebrush coral	Cnidaria	COU	0.5	-	-	3
TLD	*Tetilla leptoderma*	Furry oval sponge	Porifera	ONG	2.8	-	-	3
TOA	*Neophrynichthys* spp.	Toadfish	Teleost	-	0.9	-	-	2
TOD	*Neophrynichthys latus*	Dark toadfish	Teleost	-	15.8	-	-	7
TOP	*Ambophthalmos angustus*	Pale toadfish	Teleost	-	829.3	2	1	13
TPE	*Teuthowenia pellucida*	Teuthowenia pellucida	Cephalopod	SQX	0.4	-	-	1
TRO	*Tromikosoma* spp.	Tromikosoma spp.	Echinoderm	-	1.4	-	-	1
TRS	*Trachyscorpia capensis*	Trachyscorpia capensis	Teleost	-	18.4	1	1	6
TSQ	*Todarodes filippovae*	Todarodes filippovae	Cephalopod	SQX	555.1	12	11	11
TTL	*Tetilla australe*	Tetilla australe	Porifera	ONG	0.1	-	-	1
TUB	*Tubbia tasmanica*	Tubbia tasmanica	Teleost	-	22.4	3	-	5
TUL	*Pyura pachydermatina*	Sea tulip	Other	-	0.5	-	-	1
TVI	*Trachonurus villosus*	Trachonurus villosus	Teleost	-	0.4	-	-	1
UNF		Unidentifiable	Other	-	0.7	-	-	3
UNI	Unidentified	Unidentified	Other	-	14.7	-	-	11
URO		Sea urchin other	Echinoderm	ECN	61.8	-	-	2

Table 3 continued: Biological species or groups recorded on all Sub-Antarctic summer time series trawl surveys.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
VCO	*Antimora rostrata*	Violet cod	Teleost	-	128.8	176	123	10
VIN	*Vinciguerria* spp.	Vinciguerria spp	Teleost	-	0.6	21	14	1
VNI	*Ventrifossa nigromaculata*	Blackspot rattail	Teleost	-	55.7	-	-	13
VOL	Volutidae (Family)	Volute	Mollusc	GAS	1.0	-	-	5
VSQ	*Histioteuthis* spp.	Violet squid	Cephalopod	-	22.9	-	-	13
WAR	*Seriolella brama*	Common warehou	Teleost	-	1 633.5	175	16	3
WHR	*Trachyrincus longirostris*	Unicorn rattail	Teleost	-	78.7	35	24	6
WHX	*Trachyrincus aphyodes*	White rattail	Teleost	-	921.8	307	229	13
WIT	*Arnoglossus scapha*	Witch	Teleost	-	12.1	-	-	11
WOD	Wood	Wood	Other	-	3.3	-	-	1
WSQ	*Onyika* spp.	Warty squid	Cephalopod	WSQ	701.3	-	-	3
WWA	*Seriolella caerulea*	White warehou	Teleost	-	9 467.3	3 457	1 916	13
ZAN		Anomuran	Crustacean	-	0.1	-	-	1
ZAT	*Zoroaster alternicanthus*	Zoroaster alternicanthus	Echinoderm	SFI	0.9	-	-	1
ZFM		Rubbish fishing metals	Rubbish	-	1.8	-	-	2
ZFO		Rubbish fishing other	Rubbish	-	1.2	-	-	1
ZFT		Rubbish fishing textiles	Rubbish	-	0.1	-	-	1
ZHO		Rubbish household other	Rubbish	-	0.2	-	-	1
ZHT		Rubbish household textiles	Rubbish	-	0.3	-	-	1
ZME		Medusae	Cnidaria	-	0.7	-	-	1
ZOO		Rubbish other	Rubbish	-	11.3	-	-	2
ZOP		Rubbish other use plastics	Rubbish	-	0.3	-	-	1
ZOR	*Zoroaster* spp.	Rat-tail star	Echinoderm	SFI	103.3	-	-	9
ZSU	*Zoroaster spinulosus*	Zoroaster spinulosus	Echinoderm	SFI	0.2	-	-	1
Total					**700 009**	**389 394**	**130 537**	**13**

Table 4: Species groupings for the Sub Antarctic summer time series trawl surveys.

Group code	Group	Species or groups included in grouping
ANT	Anenomes	ACS, ANT, BOC, HMT, LIP
BTH	Deepsea skates	BTA, BTH, BTS
CDL	Deepsea cardinalfish	EPL, EPR
COU	Corals	BOO, COB, COF, COU, CRE, DDI, ERR, GOC, HDR, ISI, LLE, PAB, SOC, THO
CRB	Crabs	CRB, CVI, GMC, KCU, LLT, NCB, NEC, PAG, PHS, PZE, SDM, SMK, SPI
CSQ	Deepwater dogfish	CSQ, OSD
ECN	Urchins	ACO, ARA, CID, DHO, ECH, ECN, ECT, GOU, GPA, GRM, HIS, OBE, PCD, PMU, PSA, STC, SUR, TAM, URO
GAS	Gastropods	AER, AWI, FMA, GAS, GVO, VOL
GSC	Giant spider crab[1]	GSC, SSC
HTH	Sea cucumbers	BAM, HTH, PAM, PMO, SCC
LAN	Mesopelagic fish[2]	DIA, GYM, GYP, LAN, LHE, LPA, LPD, PHO, PRO, SYM
OCP	Octopus	AMP, BNO, EZE, OCP, OCT, OHU,
ONG	Sponge	APU, CIC, CPG, CRM, CRS, DSO, ERE, GLS, GVE, HYA, MYX, ONG, PAZ, PHB, PHW, SUA, THN, TLD, TTL
OSQ	Octopoteuthiidae squids	OSQ, TDQ
CSQ	Deepwater dogfish	CSQ, OSD
PRA	Prawns	ACA, AFO, APE, ARI, CAM, FUN, HSI, NAU, NMA, ONO, OPP, PAS, PBA, PED, PLM, PRA, PTA, SEP, SER
RBM	Ray's bream[3]	BBR, RBM, SRB
SAL	Salps	PYR, SAL
SFI	Starfish	ASR, BCH, BES, BPI, BRG, CDY, CJA, CMP, CPA, DMG, DPP, GOR, HEC, HTR, LNV, MAT, MSL, ODT, OPH, PAO, PHM, PLI, PLT, PNE, PRU, PSI, RGR, SFI, SMO, SOT, ZAT, ZOR, ZSU
SND	Shovelnose dogfish	DEQ, SND
SQX	Squid (excluding arrow, violet and warty squid)	CHQ, PSQ, RSQ, SEQ, SQU, SQX, TAG, TPE, TSQ,
WSQ	Warty squid[4]	MIQ, MRQ, WSQ

[1] The Southern spider crab *Leptomithrax australis* (SSC) are thought to be mostly Giant Spider crabs *Jacquinotia edwardsii* (GSC)

[2] PHO are of the family Phosichthyidae, not Myctophidae, but may have been mis-coded as LAN in the past.

[3] Likely to be mainly SRB, which was misclassified as RBM in the past.

[4] Mostly *Onykia ingens.*

Table 5: Maximum catch rates used to scale distribution maps in Section 9. Minimum catch rates and scaled minimum catch rates (scaled to ensure that the minimum circle size remains visible) are also given. Species codes are as given in Table 3.

Species code	Maximum catch rate (kg.km^{-2})	Minimum catch rate (kg.km^{-2})	Scaled minimum catch rate (kg.km^{-2})
BOE	7 303.5	0.2	73.0
CAS	465.5	0.1	0.1
CBO	165.7	0.2	0.2
CFA	57.9	0.1	0.1
CIN	6.2	0.1	0.1
COL	158.5	0.1	0.1
CSQ	554.8	0.3	2.8
CSU	151.6	0.1	0.1
CYP	1 113.2	0.2	11.1
ETB	173.5	0.1	0.1
ETL	215	0.1	0.1
GSH	443.8	0.1	0.1
GSP	526.3	0.1	2.6
HAK	3836	1.7	38.4
HOK	8 973.6	1.4	89.7
JAV	874.7	0.1	4.4
LCH	86.2	0.1	0.1
LDO	60.5	0.2	0.2
LIN	10 430.1	0.6	104.3
MCA	568.4	0.4	2.8
NOS	3 687.9	0.1	36.9
ORH	168	0.2	0.2
RCO	973.9	0.3	4.9
RIB	206.1	0.1	0.1
SBK	102.9	0.1	0.1
SBW	5 249.5	0.1	52.5
SDO	1 101.6	0.1	11.0
SND	1 236.3	0.5	12.4
SPD	2610	0.8	26.1
SSI	118.5	0.1	0.1
SSM	460.3	1.2	1.2
SSO	3 000.3	0.1	30.0
STA	322.5	0.1	0.1
SWA	9138	0.3	91.4
WWA	1942	0.4	19.4

Note: To ensure that the smaller catch rate proportional circle sizes remained visible on the plots the following rules were applied to the data:

1) Maximum catch rate between 1000 and 12 000 kg.km^{-2}: the scaled minimum catch rate is the maximum catch rate/100.
2) Maximum catch rate between 500 and 1000 kg.km^{-2}: the scaled minimum catch rate is the maximum catch rate/200.
3) Maximum catch rate below 500 kg.km^{-2} no scaling.

Table 6: Summary of trawl gear parameters for summer surveys of the Sub-Antarctic.

	Speed (knots)		Distance (n.mile)		Doorspread (m)		Headline height (m)	
Year	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
1991	3.5	0.06	3.0	0.15	126.4	7.02	6.7	0.31
1992	3.5	0.12	3.0	0.15	121.4	6.03	7.4	0.38
1993	3.5	0.06	3.0	0.13	120.7	6.50	7.1	0.32
2000	3.5	0.08	2.9	0.22	121.3	4.25	7.0	0.20
2001	3.5	0.12	3.0	0.12	117.5	5.19	7.1	0.25
2002	3.5	0.07	3.0	0.20	120.3	5.89	6.8	0.14
2003	3.5	0.09	3.0	0.10	122.5	2.99	7.0	0.22
2004	3.5	0.07	2.9	0.27	120.0	6.11	7.1	0.28
2005	3.5	0.05	3.0	0.10	117.1	6.53	7.2	0.22
2006	3.5	0.08	3.0	0.18	120.5	4.81	7.0	0.24
2007	3.5	0.07	3.0	0.13	114.3	7.43	7.2	0.23
2008	3.5	0.06	3.0	0.12	115.5	5.05	6.9	0.22
2009	3.5	0.08	2.9	0.24	116.6	7.07	7.0	0.22

Table 7: Summary for the core survey area of relative abundance estimates and length frequencies for the 134 species or groups for which biomass was estimated. Scientific names are provided in Table 3. “Estimated?” is a categorical description based on mean c.v. (see Section 2.7 for definitions).

Code	Common name	Distribution	Peak catch rates	Estimated?	Biomass trend	Length distribution	Mean length trend
AGR	Ribbonfish	pelagic		poor			
ANT	Anemones	appropriate		moderately well	no change		
APR	Catshark	>800		poor			
BAC	Codheaded rattail	>800	north				
BAR	Barracouta	<300	northwest	poor			
BBE	Banded bellowsfish	appropriate		poor			
BCA	Barracudina	insufficient data	east	poor			
BEE	Basketwork eel	>800	deep	poor			
BGZ	Banded giant stargazer	insufficient data	west	poor			
BJA	Blacjk javelinfish	>800	north	poor			
BNS	Bluenose	insufficient data	northwest	poor			
BOE	Black oreo	mostly >800	northeast	poor		unimodal	increase
BSH	Seal shark	>800	northwest	poor			
BSL	Black slickhead	>800	northwest	poor			
BTH	Blunt nose deepwater skates	appropriate		moderately well	no change		
CAS	Oblique banded rattail	appropriate		well	no change	bimodal	no change
CBA	Humpback rattail	>800		poor			
CBI	Two saddle rattail	<300	northwest	poor			
CBO	Bollons rattail	appropriate	northwest	moderately well	no change	multimodal	no change
CCX	Small banded rattail	appropriate	northwest	poor			
CDL	Cardinalfish (EPL and EPR)	>800	northwest	poor			
CDO	Capro dory	appropriate	northwest	poor			
CFA	Banded rattail	>800	survey area	very well	no change	unimodal	no change
CHA	Viperfish	pelagic	north	poor			
CHG	Giant chimaera	>800		poor			
CHP	Chimaera, brown	>800		poor			

Table 7 continued:

Code	Common name	Distribution	Peak catch rates	Estimated?	Biomass trend	Length distribution	Mean length trend
CIN	Notable rattail	>800	north, south	moderately well	increase	unimodal	no change
CKA	Kaiyomaru rattail	>800	north, south	poor			
CMA	Mahia rattail	>800	survey area	poor			
CMU	Abyssal rattail	>800	survey area	poor			
COL	Olivers rattail	appropriate	survey area	well	increase	unimodal	no change
COU	Coral (unspecified)	appropriate		poor			
CRB	Crab	appropriate	south, west	poor			
CSE	Serrulate rattail	>800	north, south	moderately well	decrease then increase		
CSQ	Leafscale gulper shark	>800	northwest	moderately well	increase	multimodal	increase
CSU	Four-rayed rattail	>800	northwest	moderately well	no change	multimodal	no change
CYL	Portuguese dogfish	>800	northwest	poor			
CYO	Smooth skin dogfish	>800	northwest	poor			
CYP	Longnose velvet dogfish	>800	northwest	moderately well	no change	multimodal	no change
DCS	Dawsons catshark	appropriate		poor			
DEA	Dealfish	pelagic		poor			
DSK	Deepsea spiny skate	>800		poor			
DSP	Deepsea pigfish	<300	N. Campbell Island	poor			
DWO	Deepwater octopus	>800	northwest	poor			
ECN	Echinoid (sea urchin)	appropriate		poor			
EPT	Deepsea cardinalfish	>800	northwest	poor		unimodal	no change
ETB	Baxters lantern dogfish	>800	deep	well	increase	multiimodal	no change
ETL	Lucifer dogfish	appropriate	puysegur	well	no change	multimodal	decrease
FHD	Deepsea flathead	appropriate	northwest	poor			
GAS	Gastropods	<300		moderately well	no change		
GSC	Giant spider crab	appropriate		poor			
GSH	Dark ghost shark	<300	north, west	poor		multimodal	no change
GSP	Pale ghost shark	>800	survey area	very well	no change	multimodal	no change
GSQ	Giant squid	rare		poor			
HAK	Hake	appropriate	north, west	very well	decrease	multimodal	decrease
HAP	Hapuku	<300	northwest	poor			
HCO	Hairy conger	appropriate	survey area	well	no change		

Table 7 continued:

Code	Common name	Distribution	Peak catch rates	Estimated?	Biomass trend	Length distribution	Mean length trend
HJO	Johnson's cod	>800		moderatley well	no change		
HOK	Hoki	appropriate	northwest	very well	decrease	multimodal	decrease
HTH	Sea cucumber	>800	survey area	well	no change		
JAV	Javelin fish	appropriate	survey area	very well	no change	bimodal	no change
JFI	Jellyfish	pelagic		poor			
LAN	Lanternfish fish	pelagic		moderately well	increase then decrease		
LCH	Long-nosed chimaera	>800	survey area	well	no change	multimodal	no change
LDO	Lookdown dory	appropriate	north, west	well	increase then decrease	multimodal	increase then decrease
LEG	Giant lepidion	rare		poor			
LHO	Omega prawn	>800		well	decrease		
LIN	Ling	appropriate	northwest	very well	no change	multimodal	decrease
LMU	New Zealand King Crab	>800		poor			
LYC	Lyconus spp	>800	north, east	poor			
MAK	Mako shark	pelagic		poor			
MAN	Finless flounder	appropriate	survey area	well	no change		
MCA	Ridge scaled rattail	>800	south	moderately well	no change	multimodal	no change
MOO	Moonfish	pelagic		poor			
NEB	Brodie's king crab	>800		poor			
NOS	NZ southern arrow squid	<300	west	poor		unimodal	no change
OCP	Octopod	appropriate		poor			
ONG	Sponges	appropriate	survey area	moderately well	increase		
OPI	Umbrella octopus	approprate		poor			
ORH	Orange roughy	>800	northwest	poor		multimodal	no change
OSQ	Octopoteuthiid squid	>800	north	poor			
PAH	Opah	pelagic		poor			
PDG	Prickly dogfish	appropriate		poor			
PLS	Plunkets shark	>800		poor			
POS	Porbeagle shark	pelagic		poor			
PRA	Prawns	>800	deep	poor			
PSK	Longnosed deepsea skate	>800	deep	poor			
PSY	Psychrolutes	>800	north	poor			
RAG	Ragfish	appropriate	north, east	poor			
RBM	Ray's bream	pelagic		poor			

Table 7 continued:

Code	Common name	Distribution	Peak catch rates	Estimated?	Biomass trend	Length distribution	Mean length trend
RCH	Widenosed chimaera	>800		poor			
RCO	Red cod	<300	west	poor		multimodal	no change
RIB	Ribaldo	>800	northwest	very well	no change	multimodal	decrease
RSK	Rough skate	<300		poor			
RUD	Rudderfish	appropriate	west, north	poor			
SAL	Salps	pelagic		poor			
SBI	Bigscaled brown slickhead	>800		poor			
SBK	Spineback	>800	deep	moderately well	no change	multimodal	no change
SBW	Southern blue whiting	appropriate	east	moderately well	no change	multimodal	decrease
SCD	Smallscaled cod	<300	south	poor			
SCH	School shark	<300	northwest	poor			
SCI	Scampi	appropriate	west	poor			
SCO	Swollenhead conger	appropriate	survey area	well	no change		
SDO	Silver dory	<300	northwest	poor		unimodal	no change
SFI	Starfish	appropriate	survey area	well	no change		
SKI	Gemfish	<300		poor			
SMC	Small-headed cod	>800	north	moderately well	increase		
SND	Shovelnose spiny dogfish	>800	northwest	well	increase	multimodal	no change
SOM	Little sleeper shark	insufficient data		poor			
SOR	Spiky oreo	>800	north, west	poor			
SPD	Spiny dogfish	appropriate	northwest	well	no change	multimodal	decrease
SPE	Sea perch	<300	northwest	poor			
SQX	Squid	>800	west, deep	moderately well	no change		
SRH	Silver roughy	appropriate	survey area	poor			
SSI	Silverside	appropriate	east	moderately well	no change	unimodal	no change
SSK	Smooth skate	appropriate	west	poor			
SSM	Smallscaled brown slickhead	>800	north	poor		multimodal	no change
SSO	Smooth oreo	>800	north	poor		multimodal	increase
STA	Giant stargazer	<300	northwest	well	no change	multimodal	no change

Table 7 continued:

Code	Common name	Distribution	Peak catch rates	Estimated?	Biomass trend	Length distribution	Mean length trend
SWA	Silver warehou	<300	west	poor		unimodal	no change
TAR	Tarakihi	<300	northwest	poor		unimodal	decrease
TOD	Dark toadfish	appropriate		poor			
TOP	Pale toadfish	appropriate	survey area	well	decrease		
TRS	Deepsea scorpionfish	insufficient data		poor			
TUB	*Tubbia tasmanica*	>800		poor			
VCO	Violet cod	>800		poor			
VNI	Blackspot rattail	appropriate		poor			
VSQ	Violet squids	>800		poor			
WAR	Blue warehou	<300	northwest	poor			
WHR	Unicorn rattail	>800		poor			
WHX	White rattail	>800		poor			
WIT	Witch	<300		poor			
WSQ	Warty squids	appropriate	survey area	very well	decrease		
WWA	White warehou	appropriate	Northwest	moderately well	no change	multimodal	decrease then increase

Table 8: Summary of the main maturity stages for the 33 species which had sufficient gonad stage data. Scientific names are given in Table 3.

Code	Common name	Main gonad stage(s)
BAR	Barracouta	Mature to Ripe
BGZ	Banded stargazer	Ripe
BNS	Bluenose	Resting to mature
BOE	Black oreo	Immature/Resting
BSH	Seal shark	Immature
BTH	Bluntnose deep water skates	Mature
CAS	Oblique banded rattail	Resting to mature
CFA	Banded rattail	Resting to mature
COL	Oliver's rattail	Resting and mature
CSQ	Leafscale gulper shark	Immature and resting
CYO	Smooth skin dogfish	Immature
CYP	Longnose velvet dogfish	Immature and mature
EPT	Deepsea cardinalfish	Immature and resting
ETB	Baxters lantern dogfish	Immature and mature
ETL	Lucifer dogfish	Maturing and mature
GSH	Ghost shark	Immature to resting
GSP	Pale ghost shark	Maturing and mature
HAK	Hake	All stages
HAP	Hapuku	Immature and resting
HOK	Hoki	Immature/Resting
JAV	Javelin fish	Immature/maturing and resting
LCH	Long-nosed chimaera	Mature
LDO	Lookdown dory	Resting to ripe
LIN	Ling	Resting (females), ripe (males)
MCA	Ridge scaled rattail	Immature to mature
ORH	Orange roughy	Immature or resting
PLS	Plunket's shark	Immature to mature
RBM	Ray's bream	Resting
RCH	Widenosed chimaera	Maturing
RCO	Red cod	Mature to ripe
RIB	Ribaldo	Resting
RSK	Rough skate	Immature to maturing
RUD	Rudderfish	Immature to mature
SBI	Spineback eel	Resting (males), maturing (females)
SBW	Southern blue whiting	Resting
SKI	Gemfish	Resting
SND	Shovelnose spiny dogfish	Mature to maturing
SOR	Spiky oreo	Mature to maturing
SPD	Spiny dogfish	Maturing
SPE	Sea perch	Resting/ part spent
SSI	Silverside	Immature to mature
SSM	Smallscaled brown slickhead	Mature (males, ripe (females)
SSO	Smooth oreo	Immature
STA	Giant stargazer	Resting to mature
SWA	Silver warehou	Resting
TAR	Tarakihi	Resting to ripe
WHX	White rattail	Resting
WWA	White warehou	Resting

8. FIGURES

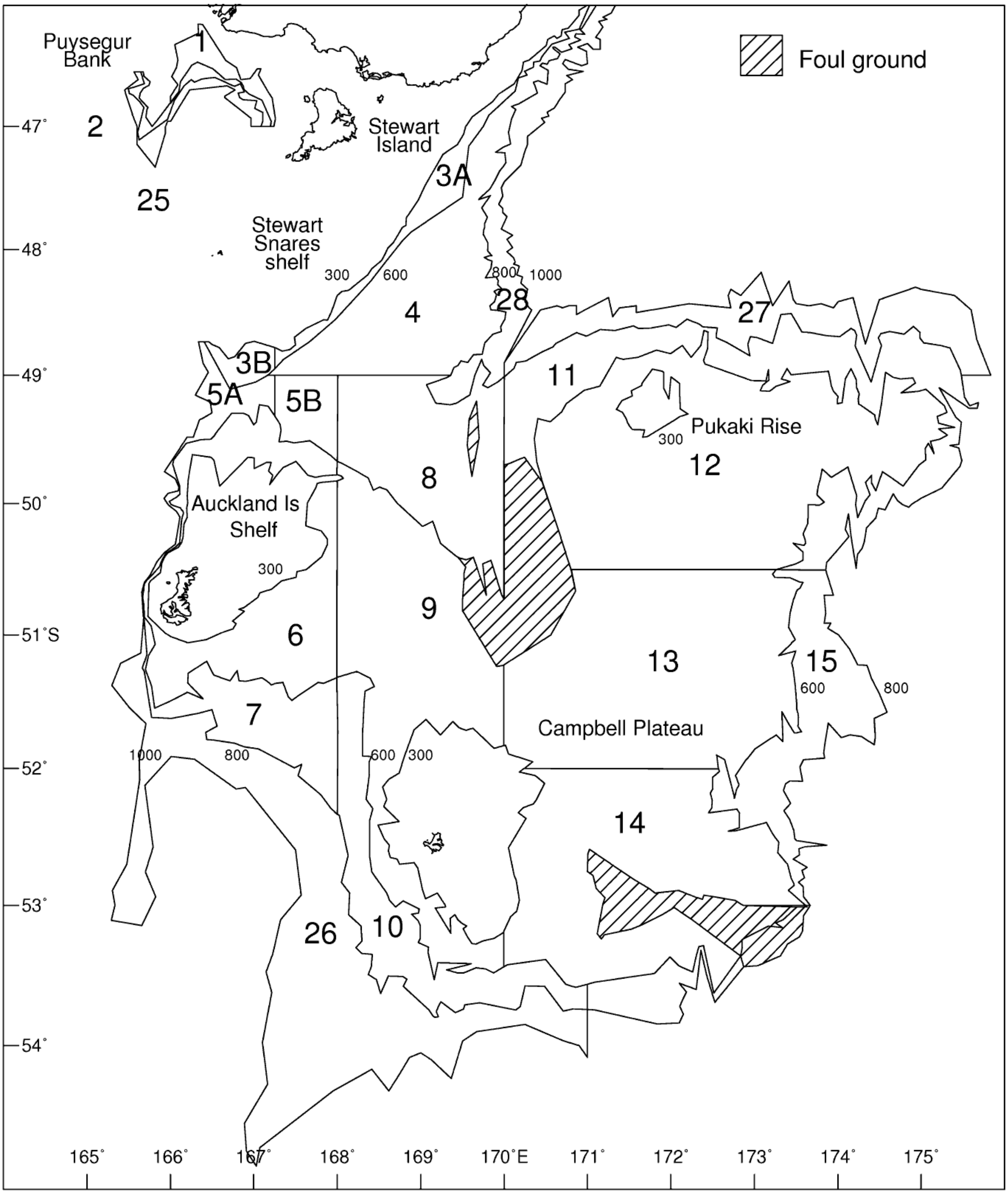

Figure 1: Sub-Antarctic trawl survey area showing stratification of the main survey area, excluding the Bounty Platform (stratum 17).

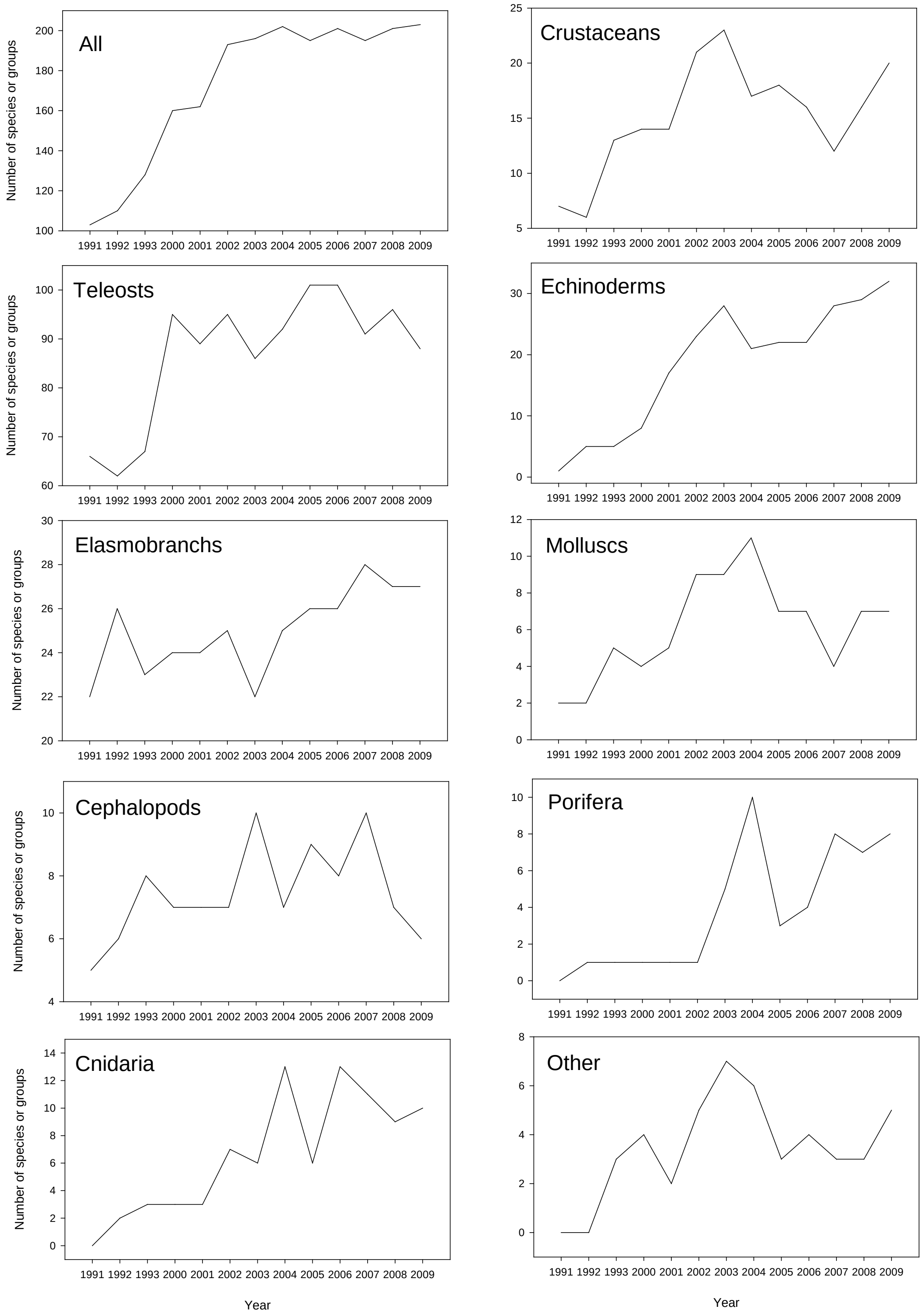

Figure 2: Number of species or groups identified on each Sub-Antarctic survey 1991–1993 and 2000–2009. Data are from all valid biomass stations and exclude rubbish codes.

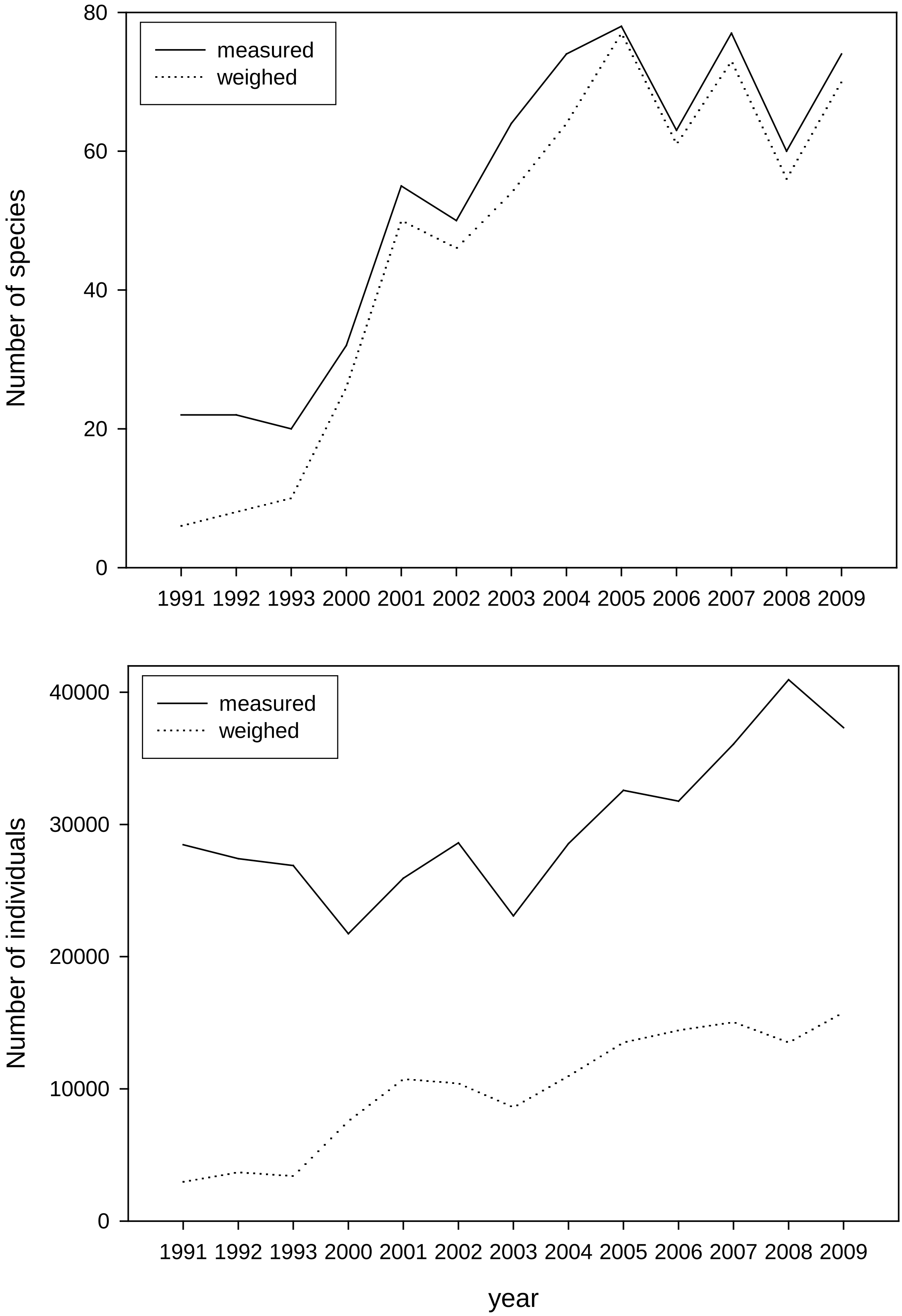

Figure 3: Number of species (upper panel) and individuals (lower panel) weighed and measured on each Sub-Antarctic survey 1991–1993 and 2000–2009. Data are from all valid biomass stations.

APPENDIX 1: SurvCalc code used to estimate abundance indices for all strata

```
@trips   tan9105 tan9211 tan9310 tan0012 tan0118 tan0219 tan0317 tan0414 tan0515 tan0617 tan0714 tan0813
tan0911

@species tan9105
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER
AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE
BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY
CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS
CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL
EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE
GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG
LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU
NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH
PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE
POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL
SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE
SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD
TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan9211
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER
AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE
BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY
CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS
CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL
EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE
GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG
LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU
NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH
PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE
POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL
SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE
SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD
TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan9310
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER
AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE
BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY
CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS
CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL
EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE
GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG
LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU
NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH
PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE
POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL
SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE
SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD
TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0012
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER
```

AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0118
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0219
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0317
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE

POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0414
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0515
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0617
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0714
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE

BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0813
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0911
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@LF_scaling numbers_in_population

@preferences tan9105
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight recorded

@preferences tan9211
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight recorded

```
@preferences tan9310
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0012
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0118
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0219
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0317
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0414
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0515
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0617
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0714
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0813
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0911
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded


@output_tables
sub_biomass_by_stratum T
biomass_by_species T
biomass_by_species_stratum T
```

```
biomass_by_species_trip T
LFs_by_stratum F
LFs_by_station F
Number_measured T
LF_totals T

@output_precision
quantity density   biomass    LF_number        cv       gain
type       dec_place  dec_place    sig_fig  dec_place  dec_place
precision     1       0          8          1          1

@input_from_database
database Empress


@where tan9105
t_station  gear_perf < 3

@where tan9211
t_station gear_perf < 3

@where tan9310
t_station gear_perf < 3

@where tan0012
t_station gear_perf < 3 and gear_meth = '01'

@where tan0118
t_station gear_perf < 3

@where tan0219
t_station gear_perf < 3 and categories !match 'RN'

@where tan0317
t_station gear_perf < 3

@where tan0414
t_station gear_perf < 3

@where tan0515
t_station gear_perf < 3

@where tan0617
t_station gear_perf < 3 and categories match 'RD'

@where tan0714
t_station gear_perf < 3 and station_no != 78 and station_no !=85 and station_no != 80

@where tan0813
t_station gear_perf < 3

@where tan0911
t_station gear_perf < 3 and station_no != 1 and station_no !=85


# tan9105
@change_strata tan9105
from 0003 0004 0005 0006 0007 0008 0009 0010  0011 0012 0013 0014 0015 0016
to   0025 0003 0004 0005 0006 0007 0008 0009  0010 0011 0012 0013 0014 0015
```

tan9211
@change_strata tan9211
from 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013 0014 0015 0016
to   0025 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013 0014 0015

tan9310
@change_strata tan9310
from 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013 0014 0015 0016
to   0025 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013 0014 0015

@change_stratum_area tan9105
strata   0001 0002 0025 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013 0014 0015
new_areas 2150 1318 1928 6104 21018 6262 16682 8497 17294 27398 11288 23008 45259 36051 27659 15179

@change_stratum_area tan9211
strata   0001 0002 0025 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013 0014 0015
new_areas 2150 1318 1928 6104 21018 6262 16682 8497 17294 27398 11288 23008 45259 36051 27659 15179

@change_stratum_area tan9310
strata   0001 0002 0025 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013 0014 0015
new_areas 2150 1318 1928 6104 21018 6262 16682 8497 17294 27398 11288 23008 45259 36051 27659 15179

APPENDIX 2: SurvCalc code used to estimate abundance indices for core strata

@trips tan9105 tan9211 tan9310 tan0012 tan0118 tan0219 tan0317 tan0414 tan0515 tan0617 tan0714 tan0813 tan0911

@species tan9105
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan9211
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan9310
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0012
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER

AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE
BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY
CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS
CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL
EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE
GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG
LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU
NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH
PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE
POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL
SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE
SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD
TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0118
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER
AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE
BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY
CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS
CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL
EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE
GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG
LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU
NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH
PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE
POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL
SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE
SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD
TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0219
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER
AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE
BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY
CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS
CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL
EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE
GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG
LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU
NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH
PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE
POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL
SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE
SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD
TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0317
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER
AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE
BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY
CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS
CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL
EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE
GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG
LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU
NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH
PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE

POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0414
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0515
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0617
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0714
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE

BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY
CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS
CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL
EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE
GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG
LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU
NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH
PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE
POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL
SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE
SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD
TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0813
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER
AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE
BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY
CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS
CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL
EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE
GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG
LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU
NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH
PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE
POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL
SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE
SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD
TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@species tan0911
codes HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH ACA ACO ACS AER
AFO AGR AMP ANT APE APR APU ARA ARI ASC ASR AWI BAC BAM BAR BBE BBR BCA BCH BEE
BES BGZ BJA BNO BNS BOC BOO BPI BRG BSH BSL BTA BTH BTS CAM CBA CBI CCX CDO CDY
CHA CHG CHP CHQ CIC CID CJA CKA CMA CMP CMU COB COF COU CPA CPG CRB CRE CRM CRS
CSE CVI CYL CYO DCS DDI DEA DEQ DHO DIA DMG DPP DSK DSO DSP DWO ECH ECN ECT EPL
EPR EPT ERE ERR EZE FHD FMA FUN GAS GLS GMC GOC GOR GOU GPA GRM GSC GSQ GVE
GVO GYM GYP HAP HCO HDR HEC HIS HJO HMT HSI HTH HTR HYA ISI JFI KCU LAE LAN LEG
LHE LHO LIP LLE LLT LMU LNV LPA LPD LYC MAK MAN MAT MIQ MOO MRQ MSL MYX NAU
NCB NEB NEC NMA OBE OCP OCT ODT OHU ONG ONO OPH OPI OPP OSD OSQ PAB PAG PAH
PAM PAO PAS PAZ PBA PCD PDG PED PHB PHM PHO PHS PHW PLI PLM PLS PLT PMO PMU PNE
POS PRA PRO PRU PSA PSI PSK PSQ PSY PTA PYR PZE RAG RBM RCH RGR RIS RSK RSQ RUD SAL
SBI SCC SCD SCH SCI SCO SDM SEP SEQ SER SFI SKA SKI SMC SMK SMO SOC SOM SOR SOT SPE
SPI SPT SQU SQX SRB SRH SSC SSK STC SUA SUR SYM TAG TAM TAR TDQ THN THO TLD TOD
TOP TPE TRS TSQ TTL TUB URO VCO VNI VOL VSQ WAR WHR WHX WIT WSQ ZAT ZOR ZSU

@LF_scaling numbers_in_population

@preferences tan9105
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan9211
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

```
@preferences tan9310
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0012
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0118
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0219
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0317
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0414
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0515
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0617
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0714
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0813
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0911
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded


@output_tables
sub_biomass_by_stratum T
biomass_by_species T
biomass_by_species_stratum T
```

```
biomass_by_species_trip T
LFs_by_stratum F
LFs_by_station F
Number_measured T
LF_totals T

@output_precision
quantity density   biomass    LF_number        cv       gain
type       dec_place  dec_place    sig_fig  dec_place  dec_place
precision     1       0          8          1          1

@input_from_database
database Empress


@where tan9105
t_station  gear_perf < 3
t_stratum  stratum != '0017'

@where tan9211
t_station gear_perf < 3
t_stratum stratum != '0017'

@where tan9310
t_station gear_perf < 3
t_stratum stratum != '0017'

@where tan0012
t_station gear_perf < 3 and gear_meth = '01'
t_stratum stratum != '0026' and stratum != '0027' and stratum != '0028'

@where tan0118
t_station gear_perf < 3
t_stratum stratum != '0026' and stratum != '0027' and stratum != '0028'

@where tan0219
t_station gear_perf < 3 and categories !match 'RN'
t_stratum stratum != '0026' and stratum != '0027' and stratum != '0028'

@where tan0317
t_station gear_perf < 3
t_stratum stratum != '0026' and stratum != '0027' and stratum != '0028'


@where tan0414
t_station gear_perf < 3
t_stratum stratum != '0026' and stratum != '0027' and stratum != '0028'

@where tan0515
t_station gear_perf < 3
t_stratum stratum != '0026' and stratum != '0027' and stratum != '0028'

@where tan0617
t_station gear_perf < 3 and categories match 'RD'
t_stratum stratum != '0026' and stratum != '0027' and stratum != '0028'


@where tan0714
t_station gear_perf < 3 and station_no != 78 and station_no !=85 and station_no != 80
t_stratum stratum != '0026' and stratum != '0027' and stratum != '0028'
```

```
@where tan0813
t_station gear_perf < 3
t_stratum stratum != '0026' and stratum != '0027' and stratum != '0028'

@where tan0911
t_station gear_perf < 3
t_stratum stratum != '0026' and stratum != '0027' and stratum != '0028'



# tan9105
@change_strata tan9105
from 0003 0004 0005 0006 0007 0008 0009 0010  0011 0012 0013 0014 0015 0016
to   0025 0003 0004 0005 0006 0007 0008 0009  0010 0011 0012 0013 0014 0015

# tan9211
@change_strata tan9211
from 0003 0004 0005 0006 0007 0008 0009 0010  0011 0012 0013 0014 0015 0016
to   0025 0003 0004 0005 0006 0007 0008 0009  0010 0011 0012 0013 0014 0015

# tan9310
@change_strata tan9310
from 0003 0004 0005 0006 0007 0008 0009 0010  0011 0012 0013 0014 0015 0016
to   0025 0003 0004 0005 0006 0007 0008 0009  0010 0011 0012 0013 0014 0015

@change_stratum_area tan9105
strata     0001 0002 0025 0003 0004  0005 0006  0007 0008  0009  0010  0011  0012  0013  0014  0015
new_areas  2150 1318 1928 6104 21018 6262 16682 8497 17294 27398 11288 23008 45259 36051 27659
15179

@change_stratum_area tan9211
strata     0001 0002 0025 0003 0004  0005 0006  0007 0008  0009  0010  0011  0012  0013  0014  0015
new_areas  2150 1318 1928 6104 21018 6262 16682 8497 17294 27398 11288 23008 45259 36051 27659
15179

@change_stratum_area tan9310
strata     0001 0002 0025 0003 0004  0005 0006  0007 0008  0009  0010  0011  0012  0013  0014  0015
new_areas  2150 1318 1928 6104 21018 6262 16682 8497 17294 27398 11288 23008 45259 36051 27659
15179
```

APPENDIX 3: SurvCalc code used to estimate length frequencies for all strata

```
@trips   tan9105 tan9211 tan9310 tan0012 tan0118 tan0219 tan0317 tan0414 tan0515 tan0617 tan0714 tan0813
tan0911

@species tan9105
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH

@species tan9211
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH

@species tan9310
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH

@species tan0012
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH

@species tan0118
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH

@species tan0219
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH

@species tan0317
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH

@species tan0414
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH

@species tan0515
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH

@species tan0617
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH

@species tan0714
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH

@species tan0813
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH

@species tan0911
codes  HOK JAV LIN SBW COL CFA GSP SSI HAK BOE SPD CSU CAS SSO NOS MCA GSH CYP WWA
ETB SND RIB SSM ORH LDO SWA ETL RCO CBO SDO STA CSQ CIN SBK LCH


@LF_scaling numbers_in_population
```

```
@preferences tan9105
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan9211
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan9310
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0012
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0118
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0219
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0317
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0414
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0515
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0617
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0714
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0813
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded
```

```
@preferences tan0911
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded


@output_tables
sub_biomass_by_stratum T
biomass_by_species T
biomass_by_species_stratum T
biomass_by_species_trip T
LFs_by_stratum F
LFs_by_station F
Number_measured T
LF_totals T

@output_precision
quantity density   biomass    LF_number        cv       gain
type       dec_place  dec_place    sig_fig  dec_place  dec_place
precision     1       0          8          1          1

@input_from_database
database Empress


@where tan9105
t_station  gear_perf < 3

@where tan9211
t_station gear_perf < 3

@where tan9310
t_station gear_perf < 3

@where tan0012
t_station gear_perf < 3 and gear_meth = '01'

@where tan0118
t_station gear_perf < 3

@where tan0219
t_station gear_perf < 3 and categories !match 'RN'

@where tan0317
t_station gear_perf < 3

@where tan0414
t_station gear_perf < 3

@where tan0515
t_station gear_perf < 3

@where tan0617
t_station gear_perf < 3 and categories match 'RD'

@where tan0714
t_station gear_perf < 3 and station_no != 78 and station_no !=85 and station_no != 80

@where tan0813
```

```
t_station gear_perf < 3

@where tan0911
t_station gear_perf < 3 and station_no != 1 and station_no !=85


# tan9105
@change_strata tan9105
from 0003 0004 0005 0006 0007 0008 0009 0010  0011 0012 0013 0014 0015 0016
to   0025 0003 0004 0005 0006 0007 0008 0009  0010 0011 0012 0013 0014 0015

# tan9211
@change_strata tan9211
from 0003 0004 0005 0006 0007 0008 0009 0010  0011 0012 0013 0014 0015 0016
to   0025 0003 0004 0005 0006 0007 0008 0009  0010 0011 0012 0013 0014 0015

# tan9310
@change_strata tan9310
from 0003 0004 0005 0006 0007 0008 0009 0010  0011 0012 0013 0014 0015 0016
to   0025 0003 0004 0005 0006 0007 0008 0009  0010 0011 0012 0013 0014 0015

@change_stratum_area tan9105
strata     0001 0002 0025 0003 0004  0005 0006  0007 0008  0009  0010  0011  0012  0013  0014  0015
new_areas  2150 1318 1928 6104 21018 6262 16682 8497 17294 27398 11288 23008 45259 36051 27659
15179

@change_stratum_area tan9211
strata     0001 0002 0025 0003 0004  0005 0006  0007 0008  0009  0010  0011  0012  0013  0014  0015
new_areas  2150 1318 1928 6104 21018 6262 16682 8497 17294 27398 11288 23008 45259 36051 27659
15179

@change_stratum_area tan9310
strata     0001 0002 0025 0003 0004  0005 0006  0007 0008  0009  0010  0011  0012  0013  0014  0015
new_areas  2150 1318 1928 6104 21018 6262 16682 8497 17294 27398 11288 23008 45259 36051 27659
15179


@lw_coeff HOK
a 0.004539513
b 2.893107

@lw_coeff LIN
a 0.001524173
b  3.255381

@lw_coeff HAK
a  0.002136175
b  3.277882

@lw_coeff BOE
a  0.02633822
b  2.927671

@lw_coeff GSH
a  0.001853226
b  3.299367

@lw_coeff GSP
a  0.01173803
b  2.829785
```

@lw_coeff JAV
a 0.0009019842
b 3.245694

@lw_coeff LDO
a 0.02704666
b 2.964245

@lw_coeff RIB
a 0.005308848
b 3.174810

@lw_coeff WWA
a 0.02322545
b 2.972842

@lw_coeff SPD
a 0.001009174
b 3.335599

@lw_coeff SBW
a 0.00339079
b 3.172698

@lw_coeff SND
a 0.00096001
b 3.300786

@lw_coeff SSO
a 0.02861948
b 2.918151

@lw_coeff ORH
a 0.06655792
b 2.796348

@lw_coeff STA
a 0.007114244
b 3.215438

@lw_coeff NOS
a 0.01400667
b 3.154444

@lw_coeff ETB
a 0.003056020
b 3.133997

@lw_coeff RCO
a 0.01908778
b 2.806483

@lw_coeff CYP
a 0.001518764
b 3.265615

@lw_coeff SDO
a 0.02980745
b 2.805783

@lw_coeff LCH
a 0.003210174
b 2.998108

@lw_coeff CSQ
a 0.001143714
b 3.347816

@lw_coeff CBO
a 0.001447551
b 3.364528

@lw_coeff SBK
a 0.002373052
b 2.934455

@lw_coeff ETL
a 0.001152540
b 3.282705

@lw_coeff CIN
a 0.01461245
b 2.449691

@lw_coeff CSU
a 0.002535452
b 2.933137

@lw_coeff SSM
a 0.004922097
b 3.153448

@lw_coeff SWA
a 0.02599216
b 2.910546

@lw_coeff MCA
a 0.004908954
b 3.008140

@lw_coeff CFA
a 0.003482386
b 3.062431
@lw_coeff SSI
a 0.013786110
b 2.766738
@lw_coeff COL
a 0.01487075
b 2.500347
@lw_coeff CAS
a 0.0007427735
b 3.5